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UNDERGROUND COAL MINING

SECTION DATA

Final Report

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## 1.0 INTRODUCTION

The objective of this contract is to provide the Jet Propulsion Laboratory (JPL) with a set of tables which display the allocation of time for ten personnel and eight pieces of underground coal mining equipment to ten function categories. These tables are presented in this report as Table 4-1 and Table 4-2. Data from 125 full shift time studies contained in the KETRON database was utilized as the primary source data. KETRON activity and delay codes were mapped onto JPL equipment, personnel and function categories. Computer processing was then performed to aggregate the shift level data and generate the matrices. Additionally, documented time study data from Jim Walter Resources, Inc. (JWR) was analyzed and used to supplement the KETRON database.

Section 2 of this report describes the source data including the number of shifts and presents specific parameters of the mines from which this data was extracted. Section 4 presents the result of the data processing including the required JPL matrices. Section 5 presents a brief comparison to a time study analysis of continuous mining systems performed by J.J. Davis Associates. [1]\*

Section 3 describes the procedures used for processing the source data.

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1\* Number in brackets [ ] refer to references in Section 5.

## 2.0 DATA SOURCES

### 2.1 KETRON Database

Over the past several years, KETRON has developed an extensive data base of time study information gathered during the course of numerous industrial engineering studies for both government and industry. These studies required the on-site collection of mine activity data by experienced mining personnel. Observers located at the miner, dump and roof bolter were able to record the begin and end times of specific events for the continuous miner, shuttle cars and roof bolter for an entire shift. This recorded data was subsequently coded and processed through a series of computer programs (COAL1-5) which output activity and delay times for equipment at each location for each shift.

Output from the COAL1-5 programs for the continuous miner includes a statistical report which presents the total time for each activity and delay as well as the frequency of occurrence, the mean, standard deviation and range. Similar reports for the dump and roof bolter were produced. These reports provide the source data for this study.

Section 3 describes the actual processing procedures used on this data. Essentially, the functional allocations for the continuous miner, the miner operator and miner helper are based on data from the COAL5 continuous miner report. Allocations for the shuttle cars and shuttle car operators are based on data from the COAL5 continuous miner and dump reports. The dump report provides shuttle car discharge times and delays while the continuous miner report provides shuttle car loading times. Roof bolter, roof bolter operator and roof bolter operator helper allocations are based entirely on the roof bolter reports.

The results presented in the tables in Section 4 represent an aggregation of data contained in four groups of data sets representing different time study projects. These projects include:

- o Freeman United Coal Company - Two mines located in Southern Illinois [2]
- o Appalachian Regional Commission - South-Western Pennsylvania Mine [3]
- o Industrial Engineering Study of Conventional Coal Mining Systems - 11 mines located throughout the U.S. [4]

Table 2-1 displays the file types and total number of shifts for each of the above projects which were used in creating the

TABLE 2-1

Total Shifts and Report Types for KETRON Source Data

<u>Mine Source</u>	<u>Report Types</u>	<u>Total Shifts</u>
Freeman United - A	Continuous Miner Dump	17 17
Freeman United - B	Continuous Miner Dump	10 10
Appalachian Regional Commission - SW PA	Continuous Miner	40
IE Study of Conventional Systems - Various U.S. Mines	Roof Bolter	31
TOTAL		125

matrices. Roof bolter data acquired during the "IE Study of Conventional Systems" is included, since the activities of the roof bolter in conventional systems are essentially the same as those in continuous mining systems.

The data files from each mine source are for multiple sections in one or more mines. Table 2-2 describes the locations, seam height, roof quality and floor quality for each mine source which has been included in the development of the matrices.

Appendix B contains the COALS reports which served as the raw data source for the construction of the matrices.

## 2.2 Jim Walter Resources Database

Time study data for the continuous miner and roof bolter were gathered and documented by industrial engineers of Jim Walter Resources Inc., (JWR) for several of their mines. For this report, three sets of data were analyzed: 1980 continuous miner data for six shifts; 1979 continuous miner data; and 1978 roof bolter data for thirty-three shifts. Raw data tables are presented in Appendix C. Times appearing on these tables were normalized by JWR on a per shift basis. Each JWR time element was converted to the appropriate JPL function classification based upon the judgment of KETRON mining personnel. These transformations are presented in Tables 2-3 and 2-4.

## 2.3 Supplemental Questionnaires

The data sources described in the previous two sections were adequate for providing data on those personnel who are directly related to a particular piece of mining equipment. Other personnel have no such direct allocation, i.e., the section foreman, mechanic, bratticeman, and utility man or helper. To complete the JPL equipment/personnel matrices, it was necessary to develop a questionnaire on each of these job functions, and submit this questionnaire to experienced mining personnel. The questionnaire was submitted to JPL and approved for use in a letter dated April 2, 1980. 5 A sample of this questionnaire appears in Appendix E.



TABLE 2-2  
Section Parameters for KETRON Source Data

PROJECT	SECTION NUMBER	LOCATION	SEAM HEIGHT	ROOF QUALITY	FLOOR QUALITY
Freeman United - A	All Sections	IL	96"	Good (Shale)	Hard & Dry
Freeman United - B	All Sections	IL	96"	Good (Shale)	Hard & Dry
Appalachian Regional Com- mission	All Sections	PA	51"	Fair (Soft Shale)	Soft & Wet
Industrial Engineering Study - Con- ventional Coal Mining Systems	1	OH	58"	Fair (Shale- Bastard Line)	Hard & Dry
	2	OH	42"-44"	Excellent (Limestone)	Hard & Dry
	3	OH	70"	Excellent (Limestone)	Hard & Dry
	4	WVA	60"	Good (Shale)	Rolling Some Standing Water
	5	WVA	84"	Fair (Clayey Shale)	Hard & Dry
	6	ALA	108"	Good (Shale)	Heaving
	7	OH	60"	Fair (Sandy Shale & Sandstone)	Soft & Wet
	8	WVA	55"	Good (Shale)	Hard & Dry
	9	WVA	70"	Average (Shale)	Hard & Dry
	10	ALA	36"	Good (sandy shale)	Excellent
	11	ALA	30"	Good (sandy shale)	Excellent

TABLE 2-3  
Continuous Miner Transformations

<u>JWR Element</u>	<u>JPL Function</u>
Travel In	Man Systems
Travel Out	Man Systems
Cutting and Loading	Coal Cutting
Cleaning By MIner	Man Systems
Cutting W/O Car	Coal Cutting
Switch With Car	Section Haulage
Switch No Car	Section Haulage
Car Change (Residual)	Section Haulage
Place Change Tram	Coal Cutting
Place Change Handle Cable	Coal Cutting
In Place Handle Cable	Coal Cutting
In Place Service Duties	Maintenance
Mine Health and Safety Delay	Man Systems
Mechanical Delay	Maintenance
Coordination Delay	Coal Cutting
Condition Delay	Coal Cutting
Gassed Out	Man Systems

TABLE 2-4

## Roof Bolter Transformations

<u>JWR Element</u>	<u>JPL Element</u>
Total Travel Time	Man Systems
Start of Shift Inspection	Man Systems
Power, Belts, Etc.	Allocated to electrical, main haulage and miner
Cable splices	Roof Support
Instruments	Roof Support
Federal Inspection Time	Man Systems
Cable Handling	Roof Support
Curtain Delay	Ventilation
Gas Check	Man Systems
Tram Time	Roof Support
Bolting Time	Roof Support
Other Cyclic Delays	Roof Support
Other Impositions	Roof Support

### 3.0 PROCESSING OF KETRON DATABASE

The allocation of KETRON activities to JPL function, equipment and personnel categories is the most critical step in the processing of our time-study data base. This section presents the transformations which have thus far been defined, discusses the data processing effort which was performed and provides an indication of which elements of the required JPL matrices must be estimated using survey results. Section 3.1 describes the transformations and Section 3.2 describes the data processing steps. Overlapping and insufficient data issues are discussed in Section 3. Appendix A contain the tables which define the transformations.

#### 3.1 Transformations

Each of the KETRON activities and delays were obtained from KETRON's COAL series master event and delay lists. These lists contain all activities which appear on the COAL5 reports. The COAL5 reports contain the elapsed time for each activity of a specific mining operation during a given shift. For each report type (Continuous Miner, Dump, Roof-Bolter), a set of tables were prepared which define the fraction of each KETRON activity and delay code which is to be allocated to JPL functions. Additional tables define the equipment and personnel assignments for each activity. The transformations defined by these tables are based upon judgments by experienced personnel who were directly involved in gathering the time study data.

Exhibits 1A to 1C of Appendix A display the allocation of KETRON activity and delay codes for each file type. Entries in these tables indicate the fraction of activity time which was allocated to a function category. The sum of the fractions for each activity must equal one. As can be seen throughout the ten charts of Exhibit 1, the great majority of the KETRON activity and delay codes fall entirely under one JPL activity/function designation.

Exhibits 2A to 2C of Appendix A present the equipment assignments. Exhibits 3A to 3C display the personnel assignments. An entry of "1" in these tables indicates that this piece of equipment or person is associated with a specific activity or delay code. These assignments are based, primarily, upon the file type from which these activities (delays) are recorded and directly reflect which pieces of equipment and men were observed. For example, activities and delays from the continuous miner file are primarily assigned to the continuous miner since data contained on this report was recorded at the section face while observing the miner.

The above transformations were utilized as follows: time for a specific activity (delay) which is read from the COAL5 reports were assigned to the appropriate equipment and personnel and allocated over functions as defined by Exhibits 1A to 1C.

### 3.2 PROCESSING

Data from the transformation tables were keypunched and the following files created:

- o Activity - Function Allocation File
- o Activity - Equipment Cross Reference File
- o Activity - Personnel Cross Reference File

Figures 3-1 to 3-3 present the data elements contained in each file. The format of each file is also shown for programming purposes. Separate files were created for each COAL5 report type.

Data from the COAL5 reports (Appendix B) were keypunched according to the format shown in Figure 3-4. A computer program was developed which input the keypunched data and aggregated the activity time for each KETRON activity and delay code. Using the cross-reference files, this program then allocated the aggregate times, to the appropriate JPL function, equipment and personnel categories. The resulting output from this program included:

- o A table containing for each KETRON activity/delay code the following:
  - Total frequency
  - Total time
  - Mean time
  - Average Standard deviation
- o Total time studied
- o Total shifts studied
- o JPL equipment and personnel matrices containing actual times instead of percentages.

A separate set of outputs were generated for each of the four time study projects.

<u>DESCRIPTION</u>	<u>COLUMNS</u>	<u>FORMAT</u>
Report Type:	1	I1
1 - Continuous Miner		
2 - Dump		
3 - Roof bolter		
Activity/Delay Indicator:	3	I1
0 - Activity		
1 - Delay		
Activity or Delay Code	4-5	I2
Fractional Allocation for each function	11-60	10F5.2

FIGURE 3-1  
ACTIVITY - FUNCTION ALLOCATION FILE

<u>DESCRIPTION</u>	<u>COLUMNS</u>	<u>FORMAT</u>
Report Type:	1	I1
1 - Continuous Miner		
2 - Dump		
3 - Roof bolter		
Activity/Delay Indicator	3	I1
0 - Activity		
1 - Delay		
Activity or Delay Code	4-5	I2
Equipment - Assignment Code	11-20	8I1
0 - Equipment is <u>not</u> assigned to activity code		
1 - Equipment is assigned to this activity code		

FIGURE 3-2

ACTIVITY - EQUIPMENT CROSS REFERENCE FILE

<u>DESCRIPTION</u>	<u>COLUMNS</u>	<u>FORMAT</u>
Report Type:	1	I1
1 - Continuous Miner		
2 - Dump		
3 - Roof bolter		
Activity/Delay Indicator	3	I1
0 - Activity		
1 - Delay		
Activity or Delay Code	4-5	I2
Personnel - Assignment Code	11-20	10I1
0 - Person is <u>not</u> assigned to activity code		
1 - Person is assigned to this activity code		

FIGURE 3-3

ACTIVITY - PERSONNEL CROSS REFERENCE FILE



<u>DESCRIPTION</u>	<u>COLUMNS</u>	<u>FORMAT</u>
Project Code:	1-3	A3
ARC - ARC project		
FU1 - Freeman United - Phase 1		
FU2 - Freeman United - Phase 2		
IEC - Conventional IE Study		
Sequence Number	5-6	I2
Two digit sequential Number for set of data		
Report Type	8	I1
1 - Miner		
2 - Dump		
3 - Roof Bolter		
Activity/Delay Code	10-11	I2
Availability Code	13	I1
Indicates overlapping activity or delay		
Number of Shifts included for this set of data	15-16	I2
Frequency	18-20	I3
Total Time	22-28	F7.0
Standard Deviation	30-36	F7.0

FIGURE 3-4  
COAL5 Report File Format

From each set of computer output, percentages were manually calculated for each cell of the JPL matrices. The percentages were weighted appropriately for each time study project and averaged across all projects. The results are the matrices presented in Tables 4-1 and 4-2.

### 3.3 Overlapping and Insufficient Data

#### 3.3.1 Overlapping Data

A potential problem with the allocation procedure is double counting. Since identical activities occur on different report types for the same shift, one must be careful not to assign the same equipment or personnel type more than once to these activities. In other words, if "mechanic" is assigned to activity "man trip in" on the continuous miner report, he cannot also be assigned to this activity on the Dump report. If he was, the mechanic's man trip time would be counted twice for a given shift. By judiciously assigning men and equipment to specific report types, this has been avoided.

#### 3.3.2 Insufficient Data

For certain equipment and personnel, there is a lack of observed time-study data. Table 3-1 indicates those pieces of equipment for which sufficient data exists and those for which survey information was required. For pieces of equipment for which time allocations are based upon actual time study data, the source of this data is indicated. Table 3-2 presents similar information for each personnel category.

TABLE 3-1

## Data Sources for Equipment Categories

EQUIPMENT TYPE	SOURCE OF DATA	FILE TYPE
Continuous Miner	Time Study	Continuous miner COAL4 file
Shuttle Car #1	Time Study	Dump COAL4, Continuous Miner COAL4
Shuttle Car #2	Time Study	Dump COAL4, Continuous Miner COAL4
Roof Bolter	Time Study	Roof Bolter COAL4
Section Belt	Time Study	Dump COAL4
Main Belt	Time Study	Dump COAL4
Rock Duster	Survey	-----
Electricals in Section	Survey	-----

TABLE 3-2

## Data Sources for Personnel Categories

PERSONNEL	SOURCE OF DATA	FILE TYPE
Continuous Miner Operator	Time Study	Continuous Miner COAL4
Continuous Miner Operator's Helper	Time Study	Continuous Miner COAL4
Shuttle Car Operator #1	Time Study	Dump COAL4, Continuous Miner COAL4
Shuttle Car Operator #2	Time Study	Dump COAL4, Continuous Miner COAL4
Roof Bolter Operator	Time Study	Roof Bolter COAL4
Roof Bolter Operator's Helper	Time Study	Roof Bolter COAL4
Section Foreman	Time Study, Survey	Continuous Miner COAL4
Mechanic	Survey	-----
Bratticeman	Survey	-----
Utility Man	Survey	-----

#### 4.0 RESULTS

Results for the JPL were obtained from three sources:

- o KETRON Database
- o Jim Walter Resources
- o Survey Questionnaire

Each of these is summarized in this section.

#### 4.1 KETRON Database

Table 4-1 presents the JPL equipment matrix. The allocations on this table represent a composite of all data used for this study and contained in the KETRON data base. Time study data for the rock duster is not available, therefore, percent allocations are based entirely upon survey data. The section belt, main belt, and section electricals are not observed directly during the time studies. However, delays and man system operations for these pieces of equipment were recorded by the observer at the dump. The difference of the recorded time and total shift time is the time that the equipment was in normal operation (i.e., section belt in section haulage, main belt in main haulage and section electricals in electricals function).

There is no distinction is made between shuttle car 1 (standard) and shuttle car 2 (off-standard) in the allocation of times to functions. While there may be slight variations between these two machines at the shift level, the differences for the aggregated data are not significant.

Table 4-2 provides the allocations of personnel to function categories. Although the time studies are designed to track the activities of equipment, it is the experience of the observers that the allocations for the operators are identical to that of their respective pieces of equipment during normal operations. Occasional activities for the section foreman, mechanic, bratticeman and utility man were recorded during the time studies for specific operations. However, this data is incomplete and therefore survey data was utilized.

#### 4.2 Processing of JWR Data

Data from published time studies made available to KETRON by JWR was utilized to create the JPL equipment and personnel matrices presented in Tables 4-3 and 4-4. Time elements were assigned the appropriate JPL function and percent allocations for each function were calculated. Only data pertaining to the

TABLE 4-1

## Equipment Matrix

KETRON Composite Data (%)

Equipment Type	Function Type									
Name	Coal Cutting	Section Haulage	Main Haulage	Roof Support	Ventilation	Rock Dusting	Electrical	Man Systems	Maintenance	Other
Miner	30.3	23.2		5.5	1.6		.9	22.6	10.7	5.2
Shuttle Car <sub>1</sub>	12.8	68.9	5.0	.1				12.8	.1	.3
Shuttle Car <sub>2</sub>	12.8	68.9	5.0	.1				12.8	.1	.3
Roof Bolter	21.2	.2		44.5	.1		.4	29.2	2.0	2.4
Section Belt		82.6	4.9					12.5		
Main Belt			87.5					12.5		
Rock Duster						7.1		12.5		80.4
Section Electricals							79.9	19.9	.2	

TABLE 4-2

Personnel Matrix

KETRON Composite Data (%)

Personnel Type	Function Type									
	Coal Cutting	Section Haulage	Main Haulage	Roof Support	Ventilation	Rock Dusting	Electrical	Man Systems	Maintenance	Other
Miner Operator	30.3	23.2		5.5	1.6		.9	22.6	10.7	5.2
Miner Helper	30.3	23.2		5.5	1.6		.9	22.6	10.7	5.2
Shuttle Car 1 Operator	12.8	68.9	5.0	.1				12.8	.1	.3
Shuttle Car 2 Operator	12.8	68.9	5.0	.1				12.8	.1	.3
Bolter Operator	21.2	.2		44.5	.1		.4	29.2	2.0	2.4
Bolter Helper	21.2	.2		44.5	.1		.4	29.2	2.0	2.4
Section Foreman	31.1		3.0	10.3	3.0		0.5	38.7	8.2	5.2
Mechanic	9.9	9.0			0.4	0.4		13.8	45.5	21.0
Brattice-Man		1.7	1.1	14.0	52.5	7.7		12.5	6.3	4.2
Utility Man		13.1	11.6		17.5	6.3		31.9	7.3	12.3
Non-Face*			8.7	6.0	6.6		22.5	18.2	13.4	24.6

\* Percentages based upon survey data.

TABLE 4-3  
Equipment Matrix  
JWR Composite Data (%)

Equipment Type	Function Type										
Name	Coal Cutting	Section Haulage	Main Haulage	Roof Support	Ventilation	Rock Dusting	Electrical	Man Systems	Maintenance	Other	
Miner	33.5	19.3						19.8	27.4		
Shuttle Car <sub>1</sub>											
Shuttle Car <sub>2</sub>											
Roof Bolter	22.5			54.6				18.5	4.4		
Section Belt											
Main Belt											
Rock Duster											
Section Electricals											



TAL 4-4

**Personnel Matrix**  
**JWR Composite Data (%)**

Personnel Type	Function Type									
	Coal Cutting	Section Haulage	Main Haulage	Roof Support	Ventilation	Rock Dusting	Electrical	Man Systems	Maintenance	Other
Miner Operator	33.5	19.3						19.8	27.4	
Miner Helper	33.5	19.3						19.8	27.4	
Shuttle Car 1 Operator										
Shuttle Car 2 Operator										
Bolter Operator	22.5			54.6				18.5	4.4	
Bolter Helper	22.5			54.6				18.5	4.4	
Section Foreman										
Mechanic										
Brattice-Man										
Utility Man										

continuous miner and roof bolter are available; therefore, times were allocated only for these pieces of equipment and their operators.

The tables appear to indicate that the time allocations are consistent with those based on the KETRON data. One significant difference is the large percentage of time allocated to maintenance for the continuous miner on the JWR data matrix. This is a result of assigning the JWR time elements of "Mechanical Delay" and "In Place Service Duties" to the maintenance functions. A more detailed breakdown of these elements would likely indicate unscheduled delays due to shuttle car breakdowns, section belt failure, ventilation repairs, etc. These delays would then be allocated to such functions as section haulage and ventilation.

#### 4.3 Questionnaire Results

The final results of the survey questionnaire are included in the two (Tables 4-1 and 4-2). A total of twenty industry personnel, compiled from a list of KETRON staff contacts, agreed to provide the necessary information. These individuals ranged in position from Mining Industrial Engineer to Operations Vice President, although all of them had, at one time, been directly associated with mine production work either as a section foreman, underground laborer, or production analyst.

A total of twelve questionnaires were ultimately returned to KETRON for analysis. It is not known why the other individuals chose not to respond. Due to time constraints, a decision was made to proceed with the tabulation and analysis without contacting additional personnel or "prompting" the non-respondents.

Tables 4-5 through 4-8 display a summary of the questionnaire response.

As shown in Tables 4-1 and 4-2, the foreman is said to spend most of his time in the man systems function, which is mainly the mantrip and various safety-related tasks. Approximately one-third of the shift is spent in coal cutting activities, which is mainly supervising the miner operations.

The largest portion (45.5 percent) of the mechanic's time is allocated to the maintenance function, as expected. The percentages listed for the coal cutting and section haulage functions represent the mechanic relieving the various equipment operators for lunch breaks. The 21 percent figure listed for the "other" category represents idle time. It was decided to place this idle time in this category rather than one of the other categories so as not to distort the figures in the specific job function type.

TABLE 4-5

## Questionnaire Results - Foreman

Time Period: 1      Percentage of Shift: 6.25

Activity	Job Function Category	Normalizations	
		Time Period	Shift
Run Faces	Man Systems	0.46	0.0288
Give Work Assignments	Man Systems	0.25	0.0156
Supervise Cut Preparation	Coal Cutting	0.15	0.0094
Check Equipment	Maintenance	0.07	0.0044
Report to Mine Manager	Other	0.03	0.0019
Energize Equipment	Electrical	0.02	0.0013
Safety Talk	Man Systems	0.02	0.0013

Time Period: 2      Percentage of Shift: 37.5

Activity	Job Function Category	Normalizations	
		Time Period	Shift
Supervise Subsequent Cut Preparation	Coal Cutting	0.23	0.0863
Equipment/Machine Checks	Maintenance	0.08	0.0300
Inspection of General Work		0.02	0.0075
Inspection of Supplies	Man Systems	0.09	0.0338
Plan Subsequent Cuts	Coal Cutting	0.04	0.0150
Methane Checks	Man Systems	0.18	0.0675
Observe Crews	50/50 Coal Cutting/ Roof Support	0.31	0.1167
Maintain Ventilation	Ventilation	0.04	0.0150
Other	Other	0.01	0.0038

TABLE 4-5 (Cont'd.)  
Questionnaire Results - Foreman

Time Period: 3

Percentage of Shift: 37.5

Activity	Job Function Category	Normalizations	
		Time Period	Shift
Observe Face Operations	Coal Cutting	0.12	0.0450
Observe Bolter	Roof Support	0.03	0.0113
Walk Belt Line	Main Haulage	0.08	0.0300
Write Maintenance List	Maintenance	0.04	0.0150
Routine Section Check	Man Systems	0.03	0.0113
Check Supplies	Man Systems	0.03	0.0113
Supervise Subsequent Cut Preparation	Coal Cutting	0.13	0.0488
Equipment/Machine Checks	Maintenance	0.05	0.0188
Inspection of Gen'l. Work	Other	0.02	0.0075
Inspection of Supplies	Man Systems	0.06	0.0225
Plan Subsequent Checks	Coal Cutting	0.04	0.0150
Methane Checks	Man Systems	0.13	0.0488
Observe Crews	50/50 Coal Cutting/ Roof Support	0.18	0.0675
Maintain Ventilation	Ventilation	0.04	0.0150
Other	Other	0.02	0.0075

Time Period: 4

Percentage of Shift: 6.25

Final Gas Checks	Man Systems	0.27	0.0169
Supervise Section Preparation	Maintenance	0.22	0.0138
Call Out Report	Other	0.29	0.0181
Check Supplies	Man Systems	0.06	0.0038
Reenergize Equipment	Electrical	0.06	0.0038
Check Equipment Location/Condition	Other	0.10	0.0063

Time Period: Mantrip In/Out

Percentage of Shift 12.5

All of Mantrip Time Placed in Man Systems Job Function Category.

TABLE 4-6

## Questionnaire Results - Mechanic

Percentage of Shift Spent Repairing Equipment: 52.0  
 Percentage of Shift on Mantrip: 12.5

Activity	Job Function Category	Normalizations	
		Time Period	Shift
REPAIR TIME	MAINTENANCE	0.5200	0.4550
NON-REPAIR TIME			
Running Equipment	50/50 Coal Cutting/ Section Haulage	0.2160	0.1890
Deadwork	Other	0.2400	0.2100
Ventilation	Ventilation	0.0048	0.0042
Supplies	Man Systems	0.0144	0.0126
Rock Dust	Rock Dusting	0.0048	0.0042

TABLE 4-7

## Questionnaire Results - Bratticeman

Percentage of Shift Spent on Non-ventilation Work: 40.0  
 Percentage of Shift on Mantrip: 12.5

Activity	Job Function Category	Normalizations	
		Time Period	Shift
VENTILATION TIME	Ventilation	0.6000	0.5250
NON-VENTILATION TIME			
Shovel Ribs	Other	0.0480	0.0420
Help Bolters	Roof Support	0.1600	0.1400
Rock Dust	Rock Dusting	0.0880	0.0770
Assist Mechanic	Maintenance	0.0720	0.0175
Run Shuttle Car	Section Haulage	0.0200	0.0175
Clean Belts	Main Haulage	0.0120	0.0105

TABLE 4-8

## Questionnaire Results - Utility Man

Percentage of Shift on Mantrip: 12.5

Activity	Job Function Category	Normalizations	
		Time Period	Shift
Help Bratticeman	Ventilation	0.2000	0.1750
Shovel Belt	Main Haulage	0.1330	0.1164
Run Equipment	Section Haulage	0.1500	0.1313
Supplies	Man Systems	0.2220	0.0726
Assist Mechanic	Maintenance	0.0720	0.0630
Rock Dust	Rock Dusting	0.0720	0.0630
Miscellaneous	Other	0.1400	0.1225

Responses for the utility man and the brattice man tended to be inconsistent. These two job functions tend to be less precise in nature; that is, there is no set job responsibility for either personnel type, although the brattice man's main responsibility is to maintain section ventilation.

The questionnaire approach used in this study was considered to be successful. The 60% response rate was not unexpected, and is considered to be reasonable, based on previous similar survey efforts. Job function results for the section foreman and the mechanic are consistent with KETRON's first-hand experience, and there was a high degree of agreement among the respondents for these two personnel types. For the last two face personnel, however, it is doubtful that any two sets of responses would be consistent, given the nature of the jobs. Similarly, the non-face personnel row tended to be mine-specific, and a wide response variation was received.

## 5.0 COMPARISONS TO J.J. DAVIS REPORT DATA

Under contract to the U.S. Bureau of Mines, J.J. Davis Associates performed a detailed industrial engineering study of continuous mining systems. 1 The scope of work for this project included time studies for the continuous miner, haulage vehicles and the roof bolter. This data is summarized in tables extracted from the report and presented in Appendix D.

It is difficult to make comparisons of the percentages displayed in these tables to those in Tables 4-1 and 4-2 due to the large percentage of time in the general categories of "Delay" and "Idle". For example, most of the idle time for a roof bolter is caused by waiting for the continuous miner; therefore, this time would be allocated to coal cutting. The KETRON time study system is designed to provide a detailed breakdown of machine delays. This permits allocation of these delays to the JPL function categories. However, the J.J. Davis study was concerned only with the actual production time for a piece of equipment, therefore, all delay times are grouped into one time element.

TABLE 5-1

Comparison of Time Study Results for Continuous Miner

	KETRON	J. J. DAVIS
Production Time	26%	27%
Non-Production Time (Includes all delays)	74%	73%

As described in Section 3, the processing of KETRON data yields the total time spent for each KETRON activity and delay code for each time-study project. From this, we were able to aggregate the times spent on production-related activities for the continuous miner. Dividing by total shifts time provided an appropriate percentage of time the miner was involved in production. This figure was then compared to the J. J. Davis percentage. The result appears in Table 5-1. Note that this is strictly a rough comparison since it is not evident which activities are considered production-related in the J. J. Davis study.



## 6.0

REFERENCES

1. J.J. Davis Associates, Industrial Engineering Study of Continuous Mining Systems, Final Report, August 8, 1977, USBM Contract J0357096.
2. KETRON, INC., Mine Productivity Study - Phase II Report, Final Report, January, 1979, Freeman United Coal Mining Company.
3. KETRON, INC., A Three Year Organizational Development Action Research Demonstration Project In An Underground Coal Mine, Draft Final Report, July, 1980, The Appalachian Regional Commission.
4. KETRON, INC., Industrial Engineering Evaluation of Underground Mining Equipment, Final Report, July, 1976, USBM Contract J0155203.
5. JPL, April 2, 1981, correspondence, JPL Contract 955966, subject: Comments on Time Study Survey Form.

## APPENDIX A

Mapping of KETRON Activities and Delays to  
JPL Function, Equipment and Personnel Categories

- Exhibit 1 - KETRON Activities/Delays vs  
JPL Job Function Categories
- Exhibit 2 - KETRON Activities/Delays  
vs JPL Equipment Categories
- Exhibit 3 - KETRON Activities/Delays  
vs JPL Personnel Categories

EXHIBIT 1  
KETRON Activities/Delays  
vs.  
JPL Job Function Categories

MACHINE FILE (continued)

NO.	ACTIVITY	ACTIVITY / FUNCTION ALLOCATION FRACTION										TOTAL
		COAL CUTTING	SECTION HAULAGE	MAIN HAULAGE	ROOF SUPPORT	VENTILATION	ROCK DUSTING	ELECTRICAL	MAIN SYSTEMS	MAINTENANCE	OTHER	
1	Cut Top 10								1.0			
2	Shovel 10								1.0			
3	Shovel 10								1.0			
4	Top 10								1.0			
5	Shovel 10								0.5	0.5		
6	Shovel 10	1.0										
7	Shovel 10	1.0										
8	Shovel 10	1.0										
9	Shovel 10	1.0										
10	Shovel 10		1.0									
11	Shovel 10	1.0										
12	Shovel 10											
13	Shovel 10	1.0										
14	Shovel 10	1.0										
15	Shovel 10	1.0										
16	Shovel 10	1.0										
17	Shovel 10	1.0							0.5	0.5		
18	Shovel 10											

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Exhibit 1a (cont'd)

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ACTIVITY		ACTIVITY / FUNCTION ALLOCATION FRACTION										TOTAL
NO.	NAME	COAL CUTTING	SECTION HAULAGE	MAIN HAULAGE	ROOF SUPPORT	VENTILATION	ROCK DUSTING	ELECTRICAL	MAIN SYSTEMS	MAINTENANCE	OTHER	
50	Coal Handling											
51	Curtain Handling					1.0						
52	Inspection & Argonation								1.0	1		
53	Section Power							1.0				
54	Section Water									1.0		
55	Sectioned Maintenance									1.0		
56	Inspected Maintenance									1.0		
57	Inspected Maintenance	1.0										
58	Loading & Sealing				1.0							
59	Placing	1.0										
60	Placing in Group											
61	Place Water Pallet				1.0							
62	Table Water Pallet				1.0							
63	Table Water Pallet										1.0	
64	Table Water Pallet											
65	Table Water Pallet	1.0										
66	Table Water Pallet											
67	Table Water Pallet											
68	Table Water Pallet											
69	Table Water Pallet											
70	Table Water Pallet											
71	Table Water Pallet					1.0						

Exhibit 1a (cont'd)

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No.	ACTIVITY	ACTIVITY / FUNCTION ALLOCATION FRACTION										TOTAL
		COAL CUTTING	SECTION HAULAGE	MAIN HAULAGE	ROOF SUPPORT	VENTILATION	ROCK DUSTING	ELECTRICAL	MAN SYSTEMS	MAIN - TENANCE	OTHER	
70	Trimming				1.0							
72	Clearing						1.0					
74	Welding					1.0						
78	Clearing								1.0			
79	Lunch								1.0			
	Trucking				0.5						0.5	
81	Safety Officer								1.0			
82	Mechanic										1.0	
83	Driver											
84	Operator	1.0										
85	Conductor				0.75						0.25	
86	Cable Repair							1.0				
87	Shuttle		1.0									
88	Loading										1.0	

Exhibit 1a (cont'd)

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ACTIVITY		ACTIVITY / FUNCTION ALLOCATION FRACTION										TOTAL
%	Name	COAL CUTTING	SECTION HAULAGE	MAIN HAULAGE	ROOF SUPPORT	VENTILATION	ROCK DUSTING	ELECTRICAL	MAIN SYSTEMS	MAIN - TENDANCE	OTHER	
1	1.0								1.0			
2	2.0								1.0			
3	3.0								1.0			
4	4.0								1.0			
5	5.0											
6	6.0		1.0									
7	7.0		1.0									
8	8.0		1.0									
9	9.0		1.0									
10	10.0		1.0									
11	11.0		1.0									
12	12.0		1.0									
13	13.0		1.0									
14	14.0		1.0									
15	15.0		1.0									
16	16.0		1.0									
17	17.0								1.0			
18	18.0								1.0			
19	19.0								1.0			
20	20.0								1.0			
21	21.0								1.0			



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S.O.C.	ACTIVITY	ACTIVITY / FUNCTION ALLOCATION FRACTION										TOTAL
		COAL CUTTING	SECTION HAULAGE	MAIN HAULAGE	ROOF SUPPORT	VENTILATION	ROCK DUSTING	ELECTRICAL	MAN SYSTEMS	MAIN TENANCE	OTHER	
50	Coal Chipping		1.0									
51	Section Haulage								1.0			
52	Section Drift							1.0				
53	Section Water									1.0		
54	Section SC Cont.									1.0		
55	Section SC Maint									1.0		
56	Section Pull Over			1.0								
57	Section Pull Over			1.0								
58	Section Pull Over			1.0								
59	Section Pull Over			1.0								
60	Section Pull Over			1.0								
61	Section Pull Over			1.0								
62	Section Pull Over			1.0								
63	Section Pull Over			1.0								
64	Section Pull Over			1.0								
65	Section Pull Over			1.0								
66	Section Pull Over			1.0								
67	Section Pull Over			1.0								
68	Section Pull Over			1.0								
69	Section Pull Over			1.0								
70	Section Pull Over			1.0								
71	Section Pull Over			1.0								
72	Section Pull Over			1.0								
73	Section Pull Over			1.0								
74	Section Pull Over			1.0								
75	Section Pull Over			1.0								
76	Section Pull Over			1.0								
77	Section Pull Over			1.0								
78	Section Pull Over			1.0								

Exhibit 1b (contd)

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ACTIVITY		ACTIVITY / FUNCTION ALLOCATION FRACTION										TOTAL
Seq	Name	COAL CUTTING	SECTION HAULAGE	MAIN HAULAGE	ROOF SUPPORT	VENTILA- TION	ROCK DUSTING	ELECTRICAL	MAINT SYSTEMS	MAINT - TECHNICAL	OTHER	
19	Long Electric								1.0			
20	Truck Haulage		1.0						1.0			
21	Other Safety											
22	Other - Maintenance		1.0								1.0	
23	Other - Safety											
24	Truck Operator Safety		1.0									
25	Other Construction				0.75						0.25	
26	Other Safety							1.0				
27	Truck Operator Safety		1.0									
28	Truck Operator Safety											
29	Truck Operator Safety			1.0								
30	Truck Operator Safety											
31	Truck Operator Safety											
32	Truck Operator Safety											
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100	Truck Operator Safety											

Exhibit 1b (cont'd)

S.O.B.	ACTIVITY	ACTIVITY / FUNCTION ALLOCATION FRACTION										TOTAL
		COAL CUTTING	SECTION HAULAGE	MAIN HAULAGE	ROOF SUPPORT	VENTILATION	ROCK DUSTING	ELECTRICAL	MAN SYSTEMS	MAINTENANCE	OTHER	
1	Hand Top 1.0								1.0			
2	Tree 1.0								1.0			
3	Machine Prep/Install								0.5	0.5		
4	Pool 1.0				1.0							
5	Installation				1.0							
6	Starts Hole Drilling				1.0							
7	Change Steel				1.0							
8	Hole Drilling				1.0							
9	Pool Post Installation				1.0							
10	Tree 1.0				1.0							
11	Prep for Steel Change				1.0							
12	Concrete Tree				1.0							
13	Machine for Tree				1.0							
14	Tree 1.0				1.0							
15	Machine for Tree				1.0							
16	Machine for Tree				1.0							
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100	Machine for Tree				1.0							

MACHINE FILE Coal Preparation

S.O.B.	ACTIVITY Name	ACTIVITY / FUNCTION ALLOCATION FRACTION										TOTAL
		COAL CUTTING	SECTION HAULAGE	MAIN HAULAGE	ROOF SUPPORT	VENTILA- TION	ROCK DUSTING	ELECTRICAL	MAN- SYSTEMS	MAIN- TENANCE	OTHER	
50	Cutter Machine				1.0							
51	Coal Handling					1.0			1.0			
52	Sectional Repulator							1.0				
53	Sectional Repulator										1.0	
54	Sectional Repulator									1.0		
55	Sectional Repulator									1.0		
56	Sectional Repulator											
57	Sectional Repulator				1.0							
58	Sectional Repulator								1.0			
59	Sectional Repulator				1.0							
60	Sectional Repulator				1.0							
61	Cutter Machine											
62	Sectional Repulator											
63	Sectional Repulator	1.0										
64	Sectional Repulator											
65	Sectional Repulator				1.0							
66	Sectional Repulator				1.0							
67	Sectional Repulator				1.0							

Exhibit 1c (cont'd)

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SNo	ACTIVITY Name	ACTIVITY / FUNCTION ALLOCATION FRACTION										TOTAL
		COAL CUTTING	SECTION HAULAGE	MAIN HAULAGE	ROOF SUPPORT	VENTILA- TION	ROCK DUSTING	ELECTRICAL	MAIN SYSTEMS	MAINTENANCE	OTHER	
65	Power To Pulver				1.0							
66	Power To Pulver											
67	Increasing Delay Time				1.0							
71	Power To Pulver											
72	Power To Pulver											
74	Power To Pulver	1.0										
75	Power To Pulver		1.0									
76	Power To Pulver										1.0	
77	Power To Pulver				1.0							
78	Power To Pulver								1.0			
79	Power To Pulver								1.0			
80	Power To Pulver				1.0							
81	Power To Pulver								1.0			
82	Power To Pulver				1.0							
83	Power To Pulver				1.0						1.0	
84	Power To Pulver				1.0							
85	Power To Pulver				1.0			1.0				
86	Power To Pulver											
87	Power To Pulver				1.0							
88	Power To Pulver				1.0							
89	Power To Pulver				1.0							

Exhibit 1c (cont'd)

EXHIBIT 2  
KETRON Activities/Delays  
vs.  
JPL Equipment Categories

# MACHINE FILE Continuous Miner - Activity

ACTIVITY		EQUIPMENT ALLOCATION										TOTAL
Seq	Name	Cont. Miner	SC #1	SC #2	Roof Bolter	Section Belt	Main Belt	Rock Duster	Section Electricals			
1	Cage Trip In	1							1			
2	Wait for Man Trip In	1							1			
3	Man Trip In	1							1			
4	Face Trip In	1							1			
5	Machine Prep/Maint	1										
6	Position for New Cut	1										
7	Cutting	1										
8	Loading SC #1	1	1									
9	Loading SC #2	1		1								
12	Waiting for SC	1										
13	Prep. for Place Charge	1										
14	Forward Tram	1										
15	Reverse Tram	1										
16	Maneuvering for Turn	1										
17	Maneuver. to Next Cut/Face	1										
18	Prep for Departure	1							1			

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Exhibit 2a (cont'd)



MACHINE FILE Continuous Miner-Delays

No	ACTIVITY	EQUIPMENT ALLOCATION										TOTAL
		Cont. Miner	SC #1	SC #2	Roof Bolter	Section Belt	Main Belt	Rock Duster	Section Electrical			
50	Cable Handling	1										
51	Curtain Handling	1										
52	Inspection & Rep.	1										
53	Section Power	1							1			
54	Section Water	1										
55	Scheduled Maint.	1										
56	Unscheduled Maint.	1										
57	Loading Delay-Maneuver	1										
58	Loading Delay-Sealing	1										
59	Bit Change	1										
60	Place Delay-Scoop	1										
61	Place Delay-Bolter	1										
62	Traffic Delay-Bolter	1										
63	Traffic Delay-Other	1										
64	Clean Up Delay	1										
65	Trimming Delay-Other	1										
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## MACHINE FILE Continuous Miner - Delays ( 1'd)

No	ACTIVITY	EQUIPMENT ALLOCATION										TOTAL
		Cont. Miner	SC #1	SC #2	Roof Bolter	Section Belt	Main Belt	Rock Duster	Section Electrical			
71	Ventilation	1										
72	Timbering	1										
73	Rock Dusting	1						1				
74	Dust/Spraying Down	1										
75	Gas Check	1										
76	Lunch	1							1			
80	Taking Bottom/Tap	1										
81	Safety - Other	1										
82	Machine - Other	1										
83	System - Other	1										
84	Operator Delay	1										
85	Conditions - Other	1										
87	Cable Repair	1										
88	Shuttle Car Delay	1	1	1								
89	Loading Out of Place	1										

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MACHINE FILE Dump - Activities

No.	ACTIVITY	EQUIPMENT ALLOCATION								TOTAL
		Cont. Miner	SC #1	SC #2	Roof Bolter	Section Belt	Main Belt	Rock Duster	Section Electricals	
1	Sage Trip In		1	1		1	1			
2	Wait on Men Trip In		1	1		1	1			
3	Men Trip In		1	1		1	1			
4	Face Trip In		1	1		1	1			
5	Preparation		1	1						
6	Discharge SC #1		1							
7	Discharge SC #2			1						
8	Dual Discharge SC #1		1							
10	Dual Discharge SC #2			1						
12	Piggyback Disch. SC #1		1							
13	Piggyback Disch. SC #2		1	1						
15	Partial Discharge SC									
17	No SC at Dump		1	1						
18	Face Trip Out		1	1		1	1			
19	Wait on Men Trip Out		1	1		1	1			
20	Men Trip Out		1	1		1	1			
21	Wait for Cage and Trip Out		1	1		1	1			

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# MACHINE FILE Dump - Delays

No.	ACTIVITY	EQUIPMENT ALLOCATION										TOTAL
		Cont. Miner	SC #1	SC #2	Roof Bolter	Section Belt	Main Belt	Rock Duster	Section Electrically			
50	Cable Handling		1	1								
52	Clean Up Dump Area		1	1								
53	Section Power		1	1		1						
54	Section Water		1	1								
55	Scheduled SC Maint.		1	1								
56	Unscheduled SC Maint.		1	1								
57	Section Belt - Other		1	1		1						
58	Main Belt Down/Car Off Track		1	1		1	1					
60	Belt Overhaul/Misc. New Car Up		1	1		1	1					
66	Section Belt - Rock		1	1		1						
67	SC Positioning		1	1								
68	SC Operator Delay		1	1								
69	SC Delay - Supplies		1	1								
75	SC Delay - Traffic		1	1								
77	Inspecting Dump Area		1	1								
78	Feeder Down - Rock		1	1								
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Exhibit 2b (cont'd)

# MACHINE FILE Roof Bolter Activities

No	ACTIVITY	EQUIPMENT ALLOCATION										TOTAL
		Cont. Miner	SC #1	SC #2	Roof Bolter	Section Belt	Main Belt	Rock Duster	Section Electricals			
1	Man Trip In				1			1				
2	Face Trip In				1			1				
3	Machine Prep/Maint.				1			1				
5	Roof Marking				1							
6	Positioning				1							
7	Stacker Hole Drilling				1							
8	Change Steel				1							
9	Hole Drilling				1							
10	Roof Bolt Insertion				1							
12	Face Trim				1							
13	Prep. for Place Change				1							
14	Forward Trim				1							
15	Maneuver for Turn				1							
16	Trim to New Place				1							
24	Reverse Trim				1							
47	Prepare for Departure				1			1				
48	Face Trip Out				1			1				
49	Man Trip Out				1			1				

9950-601

# MACHINE FILE Roof Bolter - Delays

9950-601

ACTIVITY		EQUIPMENT ALLOCATION										TOTAL
No.	Name	Cont. Miner	SC #1	SC #2	Roof Bolter	Section Belt	Main P.I.T	Rock Druster	Section Electricals			
50	Cable Handling				1							
51	Curtain Handling				1							
52	Inspection & Prep.				1							
53	Section Power				1				1			
54	Section Water				1							
55	Scheduled Maint.				1							
56	Unscheduled Maint.				1							
57	Suction Delay				1							
58	Supply Delay				1							
59	Wait on Other Drill				1							
60	Safety Jack				1							
61	Cutter Piece Delay				1							
62	Face Drill "				1							
63	Loader "				1							
64	Insert Wrench Delay				1							
65	Clean Dust Collector				1							
67	Test Hole Delay				1							

Exhibit 26 Cont'd

MACHINE FILE Roof Bolter - Delays Con

ACTIVITY		EQUIPMENT ALLOCATION								TOTAL
Seq	Name	Cont. Miner	Sc #1	SC #2	Roof Bolter	Section Belt	Main Belt	Rock Duster	Section Electricals	
68	Torque Test Delay				1					
69	Shooting Delay				1					
70	Trimming Delay - Mix				1					
71	Cutter Traffic Delay				1					
72	Face Drill "				1					
73	Loader "				1					
74	" "				1					
75	SC				1					
76	Scarf				1					
77	Bolting Out of Place				1					
78	Gas Check				1					
79	Lunch				1					
80	Loose Bolt Delay				1					
81	Safety - Other				1					
82	Machine - Other				1					
83	System - Other				1					
84	Operator Delay				1					
85	Conditions - other				1					
86	Bit Change				1					
87	Cable Splice				1					
88	Sealing				1					
89	Roof/Bolt Fall Delay				1					



EXHIBIT 3  
KETRON Activities/Delays  
vs.  
JPL Personnel Categories

## MACHINE FILE Continuous Miner - Activity

SOG	ACTIVITY	PERSONNEL ALLOCATION										TOTAL
		miner operator	miner helper	SC #1 operator	SC #2 operator	Boiler Operator	Boiler Helper	Section Foreman	Mechanic	Brattice-men	Utility Man	
1	Cage Trip In	1	1					1	1			
2	Wait for Men Trip In	1	1					1	1			
3	Men Trip In	1	1					1	1			
4	Face Trip In	1	1					1	1			
5	Machine Prep/Maint	1	1						1			
6	Position for New Cut	1	1									
7	Cutting	1	1									
8	Loading SC #1	1	1	1								
9	Loading SC #2	1	1		1							
12	Waiting for SC	1	1									
13	Prep for Piece Change	1	1									
14	Forward Train	1	1									
15	Reverse Train	1	1									
16	Maneuvering for Turn	1	1									
17	Maneuvering to Next Cut/Face	1	1									
18	Prep for Departure	1	1									



# MACHINE FILE Continuous Miner-Delays

9950-601

ACTIVITY		PERSONNEL ALLOCATION											TOTAL
%	Name	Miner Operator	Miner Helper	SC #1 Operator	SC #2 Operator	Boiler Operator	Boiler Helper	Section Foreman	Mechanic	Brattice Man	Utility Man		
50	Cable Handling	1	1										
51	Curtain Handling	1	1							1			
52	Inspection & Prep.	1	1					1					
53	Section Power	1	1					1					
54	Section Water	1	1					1					
55	Scheduled Maint.	1	1						1				
56	Unscheduled Maint.	1	1						1				
57	Loading Delay-Maneuver	1	1										
58	Loading Delay-Sealing	1	1										
59	Bit Change	1	1										
62	Place Delay-Scoop	1	1										
63	Place Delay-Boiler	1	1										
65	Traffic Delay-Boiler	1	1										
66	Traffic Delay-Other	1	1										
67	Clean Up Delay	1	1										
70	Trimming Delay-Other	1	1										

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7-2101

MACHINE FILE Dump - Activities

No.	ACTIVITY	PERSONNEL ALLOCATION										TOTAL
		Miner Operator	Miner Helper	SC #1 Operator	SC #2 Operator	Boiler Operator	Boiler Helper	Section Foreman	Mechanic	Brattice Man	Utility Man	
1	Cage Trip In			1	1					1	1	
2	Wait on Men Trip In			1	1					1	1	
3	Men Trip In			1	1					1	1	
4	Face Trip In			1	1					1	1	
5	Preparation			1	1							
6	Discharge SC #1			1								
7	Discharge SC #2				1							
9	Dual Discharge SC #1			1								
10	Dual Discharge SC #2				1							
12	Piggyback Disch. SC #1			1								
13	Piggyback Disch. SC #2				1							
15	Partial Discharge SC			1	1							
17	No SC at Dump			1	1							
18	Face Trip Out			1	1					1	1	
19	Wait on Men Trip Out			1	1					1	1	
20	Men Trip Out			1	1					1	1	
21	Wait for Cage and Trip Out			1	1					1	1	

MACHINE FILE Dump - Delays

No.	ACTIVITY	PERSONNEL ALLOCATION										TOTAL
		Miner Operator	Miner Helper	SC #1 Operator	SC #2 Operator	Boiler Operator	Boiler Helper	Section Foreman	Mechanic	Battie men	Utility men	
50	Cable Handling			1	1							
52	Clean Up Dump Area			1	1						1	
53	Section Power			1	1					1	1	
54	Section Water			1	1					1	1	
55	Scheduled SC Maint.			1	1				1			
56	Unscheduled SC Maint.			1	1				1			
57	Section Belt - Other			1	1							
58	Main Belt Down/Car Off Track			1	1							
60	Belt Overhaul/Miner Near Car Up			1	1							
66	Section Belt - Rocks			1	1							
67	SC Positioning			1	1							
68	SC Operator Delay			1	1							
69	SC Delay - Supplies			1	1					1	1	
75	SC Delay - Traffic			1	1							
77	Inspecting Dump Area			1	1			1				
78	Feeder Down - Rock			1	1						1	

## Dump-Delays (cont'd)

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Exhibit 3b (cont'd)



# MACHINE FILE Roof Bolter-Activities

So	ACTIVITY	PERSONNEL ALLOCATION										TOTAL
		Miner Operator	Miner Helper	SC #1 Operator	SC #2 Operator	Bolter Operator	Bolter Helper	Section Foreman	Mechanic	Brattice Men	Utility Men	
1	Man Trip In					1	1					
2	Face Trip In					1	1					
3	Machine Prep/Maint.					1	1		1			
5	Roof Marking					1	1					
6	Positioning					1	1					
7	Starter Hole Drilling					1	1					
8	Change Steel					1	1					
9	Hole Drilling					1	1					
10	Roof Bolt Insertion					1	1					
12	Face Trim					1	1					
13	Prep. for Place Change					1	1					
14	Forward Trim					1	1					
15	Maneuver for Turn					1	1					
16	Trim to New Place					1	1					
24	Reverse Trim					1	1					
47	Prepare for Departure					1	1					
48	Face Trip Out					1	1					
49	Man Trip Out					1	1					

# MACHINE FILE Roof Bolter-Delays

No.	ACTIVITY Name	PERSONNEL ALLOCATION										TOTAL
		Miner Operator	Miner Helper	SC #1 Operator	SC #2 Operator	Bolter Operator	Bolter Helper	Section Foreman	Mechanic	Brattice man	Utility Men	
50	Cable Handling					1	1					
51	Curtain Handling					1	1			1	1	
52	Inspection & Prep.					1	1	1				
53	Section Power					1	1					
54	Section Water					1	1					
55	Scheduled Maint.					1	1		1			
56	Unscheduled Maint.					1	1		1			
57	Suction Delay					1	1					
58	Supply Delay					1	1				1	
59	Wait on Other Drill					1	1					
60	Safety Jack					1	1					
61	Cutter Place Delay					1	1					
62	Face Drill "					1	1					
63	Loader "					1	1					
64	Insert Wrench Delay					1	1					
65	Clean Dust Collector					1	1					
66	Test Hole Delay					1	1					

MACHINE FILE Roof Bolter-Delays (cont'd)

No.	ACTIVITY	PERSONNEL ALLOCATION										TOTAL
		Miner Operator	Miner Helper	SC#1 Operator	SC#2 Operator	Bolter Operator	Bolter Helper	Section Foreman	Mechanic	Brattice men	Utility men	
68	Torque Test Delay				1	1	1					
69	Shooting Delay					1	1					
70	Tremming Delay-Miss				1	1	1					
71	Cutter Traffic Delay				1	1	1					
72	Face Drill "				1	1	1					
73	Loader "				1	1	1					
74	SC "					1	1					
75	SC "					1	1				1	
76	Scrap					1	1					
77	Bolting Out of Place					1	1					
78	Gas Check					1	1	1				
79	Lunch					1	1					
80	Loose Bolt Delay					1	1					
81	Safety-Other					1	1	1				
82	Machine-Other					1	1					
83	System - Other					1	1					
84	Operator Delay					1	1					
85	Conditions - other					1	1					
86	Bit Change					1	1					
87	Cable Splice					1	1				1	
88	Sealing					1	1					
89	Roof/Bolt Fall Delay					1	1	1	1	1	1	

Exhibit 3C (cont'd)

APPENDIX B  
COALS Reports

Freeman United Coal Mining Company

Mine A

Continuous Miner Source Data  
Dump Source Data

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9950-601

OVERALL SUMMARY FOR 3 DAYS

ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	3.	1.0	6.08	2.03	0.04	2.08	1.98
WAITING FOR MAN TRIP IN	3.	1.0	13.79	4.60	2.99	8.37	1.05
MAN TRIP IN	3.	1.0	42.03	14.01	5.01	20.35	8.10
FACE TRIP IN	3.	1.0	21.72	7.24	2.35	10.18	4.42
MACHINE PREP/MAINTENANCE	3.	1.0	9.02	3.01	2.58	6.65	1.00
CUTTING	195.	65.0	100.73	0.52	0.39	2.17	0.03
LOADING STANDARD SHUTTLE CAR	120.	40.0	186.07	1.55	0.89	5.88	0.52
LOADING OFF-STANDARD SHUTTLE CAR	104.	34.7	195.57	1.88	0.84	5.46	0.70
LOADING AND/OR CUTTING	293.	84.3	396.58	1.57	0.95	5.88	0.10
WAITING FOR SHUTTLE CAR	245.	81.7	448.89	1.83	2.19	28.28	0.10
PREPARATION FOR PLACE CHANGE	17.	5.7	18.11	1.07	1.27	5.18	0.20
FORWARD TRAM	8.	2.7	12.46	1.56	1.27	4.58	0.34
REVERSE TRAM	7.	2.3	10.82	1.55	0.75	3.25	0.75
MANEUVERING FOR TURN	12.	4.0	13.22	1.10	0.40	2.12	0.55
MANEUVERING TO NEXT CUT/FACE	4.	1.3	14.52	3.63	1.23	5.62	2.57
PREPARATION FOR DEPARTURE	3.	1.0	5.61	1.87	1.16	2.73	0.23
FACE TRIP OUT	3.	1.0	8.28	2.76	1.54	4.93	1.47
WAITING FOR MAN TRIP OUT	3.	1.0	11.19	3.73	2.29	5.67	0.52
MAN TRIP OUT	3.	1.0	33.24	11.08	3.90	14.00	5.57
WAITING ON CAGE AND TRIP OUT	3.	1.0	30.59	10.20	0.82	11.00	9.07
FORWARD TRAM - END	15.	5.0	22.71	1.51	1.06	4.45	0.02
REVERSE TRAM - BEGIN	12.	4.0	15.06	1.25	0.83	3.30	0.02

DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CABLE HANDLING DELAY	18.	6.0	17.04	0.95	1.17	4.33	0.05
INSPECTION AND PREPARATION	7.	2.3	14.42	2.06	1.50	4.62	0.03
SECTION WATER	2.	0.7	11.08	5.54	4.04	9.58	1.50
MAINTENANCE DELAY - SCHEDULED	1.	0.3	14.63	14.63	0.0	14.63	14.63
MAINTENANCE DELAY - UNSCHEDULED	5.	1.7	5.80	1.16	1.49	4.02	0.12
LOADING DELAY - MANEUVERING	25.	8.3	36.21	1.45	0.79	3.43	0.12
RIT CHANGE	1.	0.3	1.77	1.77	0.0	1.77	1.77
TRAFFIC DELAY - BOLLTER	7.	2.3	10.78	1.54	1.15	3.52	0.17
CLEAN UP DELAY	20.	6.7	34.23	1.71	1.28	5.03	0.35
TRAMMING DELAY - OTHER	1.	0.3	0.85	0.85	0.0	0.85	0.85
VENTILATION	11.	3.7	43.24	3.93	5.66	21.15	0.58
DUST OFLAY/SPRAYING DOWN	1.	0.3	7.15	7.15	0.0	7.15	7.15
TAKING BOTTOM/TOP	4.	1.3	5.82	1.45	0.86	2.38	0.40
SYSTEM - OTHER	2.	0.7	18.55	9.28	8.99	18.27	0.28
OPERATOR DELAY	49.	16.3	11.47	0.23	0.25	1.22	0.03
SHUTTLE CAR OFLAY	9.	3.0	28.35	3.15	4.27	13.22	0.18
LOADING OUT OF PLACE	5.	1.7	9.36	1.87	0.70	2.98	0.90

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OVERALL SUMMARY FOR 3 DAYS

ACTIVITIES-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	3.	1.0	6.08	2.03	0.04	2.08	1.98
WAITING ON MAN TRIP IN	3.	1.0	13.79	4.60	2.99	8.37	1.05
MAN TRIP IN	3.	1.0	42.03	14.01	5.01	20.35	8.10
FACE TRIP IN	1.	0.3	6.03	6.03	0.0	6.03	6.03
PREPARATION	1.	0.3	3.75	3.75	0.0	3.75	3.75
DISCHARGE STANDARD SC	116.	38.7	98.09	0.85	0.19	1.47	0.15
DISCHARGE OFF STANDARD SC	101.	33.7	87.04	0.86	0.23	2.05	0.50
DUAL DISCHARGE STANDARD SC	1.	0.3	2.27	2.27	0.0	2.27	2.27
DUAL DISCHARGE OFF STANDARD SC	2.	0.7	3.28	1.64	0.02	1.86	1.62
PIGGYBACK DISCHARGE STANDARD SC	2.	0.7	1.05	0.52	0.15	0.67	0.38
PIGGYBACK DISCHARGE OFF STD SC	1.	0.3	1.14	1.14	0.0	1.14	1.14
PARTIAL DISCHARGE SC	1.	0.3	1.41	1.41	0.0	1.41	1.41
ANY SC DISCHARGING	221.	73.7	192.09	0.87	0.24	2.27	0.15
NO SC AT DUMP	223.	74.3	1021.74	4.56	5.26	39.48	0.53
FACE TRIP OUT	1.	0.3	2.00	2.00	0.0	2.00	2.00
WAITING ON MAN TRIP OUT	3.	1.0	11.19	3.73	2.29	5.67	0.52
MAN TRIP OUT	3.	1.0	33.24	11.08	3.90	14.00	5.57
WAITING FOR CAGE AND TRIP OUT	3.	1.0	30.59	10.20	0.82	11.00	9.07

DELAYS-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CABLE HANDLING DELAY	2.	0.7	4.60	2.30	0.55	2.85	1.75
SECTION POWER	1.	0.3	0.37	0.37	0.0	0.37	0.37
SC MAINTENANCE DELAY-UNSCHEDULED	2.	0.7	7.61	3.80	2.47	6.28	1.33
SECTION BELT DOWN-OTHER	1.	0.3	6.95	6.95	0.0	6.95	6.95
SC DELAY-POSITIONING	2.	0.7	0.95	0.48	0.25	0.73	0.22
SMUTLE CAR OPERATOR DELAY	16.	5.3	5.73	0.36	0.24	0.87	0.10
OTHER-SYSTEM	3.	1.0	5.56	1.85	1.17	3.50	0.93
OTHER-CONDITIONS	2.	0.7	10.45	5.22	4.24	9.47	0.98

9950-60

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OVERALL SUMMARY F. 3 DAYS

ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	3.	1.0	6.23	2.08	0.14	2.27	1.98
WAITING FOR MAN TRIP IN	3.	1.0	22.01	7.34	1.17	9.15	5.83
MAN TRIP IN	3.	1.0	47.65	15.88	2.15	18.92	14.18
FACE TRIP IN	3.	1.0	23.79	7.93	5.86	14.50	0.27
MACHINE PREP/MAINTENANCE	3.	1.0	9.73	3.24	3.70	8.47	0.33
CUTTING	89.	0.9	30.04	10.34	0.19	1.04	0.07
LOADING STANDARD SHUTTLE CAR	122.	40.7	138.09	1.13	0.77	4.93	0.18
LOADING OFF-STANDARD SHUTTLE CAR	131.	43.7	141.13	1.08	0.50	3.27	0.32
LOADING AND/OR CUTTING	273.	91.0	283.54	1.04	0.67	4.93	0.07
WAITING FOR SHUTTLE CAR	269.	89.7	303.46	1.13	1.37	19.80	0.08
PREPARATION FOR PLACE CHANGE	15.	5.0	9.17	0.61	0.45	1.77	0.15
FORWARD TEAM	6.	2.0	16.84	2.81	2.23	6.60	1.03
REVERSE TEAM	6.	2.0	11.43	1.90	0.43	2.40	1.00
MANUFACTURING FOR TURN	12.	4.0	23.48	1.96	1.85	6.32	0.15
MANUFACTURING TO NEXT CUT/FACE	3.	1.0	5.98	1.99	1.28	2.95	0.18
PREPARATION FOR DEPARTURE	3.	1.0	5.14	1.71	0.76	2.77	1.02
FACE TRIP OUT	3.	1.0	24.35	8.12	2.73	10.10	4.25
WAITING FOR MAN TRIP OUT	3.	1.0	16.85	5.62	2.98	8.47	1.50
MAN TRIP OUT	3.	1.0	40.10	13.37	1.03	14.18	11.92
WAITING ON CAGE AND TRIP OUT	3.	1.0	21.69	7.23	3.99	12.67	3.20
FORWARD TEAM - END	13.	4.3	26.39	2.03	1.20	4.27	0.48
REVERSE TEAM - BEGIN	12.	4.0	18.01	1.50	0.83	3.07	0.25

DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE HANDLING DELAY	15.	5.0	16.34	1.09	1.15	4.98	0.12
INSPECTION AND PREPARATION	3.	1.0	4.96	1.65	0.81	2.70	0.73
SECTION POWER	2.	0.7	1.61	0.80	0.27	1.08	0.53
MAINTENANCE DELAY - SCHEDULED	2.	0.7	41.49	20.74	11.28	32.02	9.47
MAINTENANCE DELAY - UNSCHEDULED	14.	4.7	139.21	9.94	22.71	83.77	0.05
LOADING DELAY - MANUFACTURING	24.	8.0	41.87	1.74	2.58	13.13	0.07
BIT CHANGE	1.	0.3	5.97	5.97	0.0	5.97	5.97
PLACE DELAY - SCOOP	1.	0.3	8.93	8.93	0.0	8.93	8.93
PLACE DELAY - ROLLER	3.	1.0	40.92	13.64	11.40	29.12	2.00
TRAFFIC DELAY - ROLLER	11.	3.7	34.20	3.11	3.40	11.67	0.48
TRAFFIC DELAY - OTHER	2.	0.7	4.63	2.31	0.91	3.23	1.40
CLEAN UP DELAY	5.	1.7	5.38	1.08	0.99	2.60	0.27
VENTILATION	4.	1.3	12.33	3.08	4.63	11.10	0.20
TIMING DELAY	1.	0.3	24.91	24.91	0.0	24.91	24.91
DRIFT DELAY/SOPRATING DOWN	2.	0.7	13.57	6.78	6.19	12.97	0.60
TAKING BOTTOM/TOP	1.	0.3	0.80	0.80	0.0	0.80	0.80
MACHINE - OTHER	1.	0.3	0.40	0.40	0.0	0.40	0.40
OPERATING DELAY	41.	13.7	23.65	0.58	2.64	17.23	0.03
SHUTTLE CAR DELAY	1.	0.3	0.05	0.05	0.0	0.05	0.05
LOADING OUT OF FACE	7.	2.3	74.87	10.70	15.44	39.57	0.03



OVERALL SUMMARY FOR 3 DAYS

ACTIVITIES-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	3	1.0	6.23	2.08	0.14	2.27	1.98
WAITING ON MAN TRIP IN	3	1.0	22.01	7.34	1.37	9.15	5.83
MAN TRIP IN	3	1.0	47.65	15.88	2.15	18.92	14.18
FACE TRIP IN	1	0.3	19.37	19.37	0.0	19.37	19.37
DISCHARGE STANDARD SC	131	43.7	79.70	0.61	0.10	1.06	0.32
DISCHARGE OFF STANDARD SC	140	46.7	85.35	0.61	0.17	2.01	0.37
DUAL DISCHARGE STANDARD SC	1	0.3	2.08	2.08	0.0	2.08	2.08
PISTONBACK DISCHARGE OFF STD SC	1	0.3	0.68	0.68	0.0	0.68	0.68
ANY SC DISCHARGING	272	90.7	167.13	0.61	0.16	2.08	0.32
NO SC AT DUMP	275	91.7	1026.00	3.73	8.82	110.72	9.26
WAITING ON MAN TRIP OUT	3	1.0	16.85	5.62	2.98	8.47	1.50
MAN TRIP OUT	3	1.0	40.10	13.37	1.03	14.18	11.92
WAITING FOR CAGE AND TRIP OUT	3	1.0	21.69	7.23	3.99	12.67	3.20

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DELAYS-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
SECTION POWER	1	0.3	1.15	1.15	0.0	1.15	1.15
SECTION WFLT DOWN-OTHER	5	1.7	27.97	5.59	4.93	13.05	0.25
SHUTTLE CAR OPERATOR DELAY	5	1.7	3.49	0.70	0.54	1.45	0.10
INSPECTING DUMP AREA	1	0.3	0.28	0.72	0.0	0.72	0.72
FEEDER DOWN-BACK	9	3.0	5.14	0.57	0.49	1.92	0.20
FEEDER DOWN-OTHER	1	0.3	1.02	1.02	0.0	1.02	1.02
OTHER-SYSTEM	1	0.3	5.47	5.47	0.0	5.47	5.47

## OVERALL SUMMARY FOR 3 DAYS

## ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	3.	1.0	5.13	1.71	0.38	1.98	1.17
WAITING FOR MAN TRIP IN	3.	1.0	31.26	10.42	3.08	14.12	6.57
MAN TRIP IN	3.	1.0	41.42	13.81	1.43	15.22	11.85
FACE TRIP IN	3.	1.0	24.88	8.29	2.52	10.60	4.78
MACHINE PREP/MAINTENANCE	2.	0.7	0.73	0.36	0.04	0.40	0.33
POSITIONING FOR NEW CUT	1.	0.3	0.87	0.87	0.0	0.87	0.87
CUTTING	50.	16.7	36.37	0.73	0.40	2.13	0.12
LOADING STANDARD SHUTTLE CAR	64.	21.3	122.45	1.91	0.97	4.83	0.62
LOADING OFF-STANDARD SHUTTLE CAR	61.	20.3	115.08	1.89	1.07	6.82	0.29
LOADING AND/OR CUTTING	134.	44.7	242.02	1.81	1.05	6.82	0.13
WAITING FOR SHUTTLE CAR	129.	43.0	203.04	1.57	2.63	18.27	0.10
PREPARATION FOR PLACE CHANGE	6.	2.0	2.15	0.36	0.35	1.05	0.03
FORWARD TRAM	7.	2.3	2.15	3.02	1.15	4.43	1.20
REVERSE TRAM	3.	1.0	8.61	2.87	1.07	3.93	1.40
MANEUVERING FOR TURN	5.	1.7	1.03	0.21	0.15	0.43	0.02
MANEUVERING TO NEXT CUT/FACE	4.	1.3	3.46	0.86	0.35	1.37	0.52
PREPARATION FOR DEPARTURE	2.	0.7	5.67	2.84	0.28	3.12	2.55
FACE TRIP OUT	3.	1.0	12.45	4.15	2.88	7.17	0.28
WAITING FOR MAN TRIP OUT	3.	1.0	10.71	3.57	3.33	8.28	1.20
MAN TRIP OUT	3.	1.0	38.94	12.98	2.83	15.18	8.98
WAITING ON CAGE AND TRIP OUT	3.	1.0	13.58	4.53	2.04	7.40	2.88
FORWARD TRAM - END	8.	2.7	15.08	1.88	1.46	4.45	0.02
REVERSE TRAM - BEGIN	5.	1.7	7.91	1.58	1.59	4.30	0.02

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## DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CABLE HANDLING DELAY	6.	2.0	9.70	1.62	0.96	3.18	0.22
INSPECTION AND PREPARATION	1.	0.3	4.35	4.35	0.0	4.35	4.35
MAINTENANCE DELAY - SCHEDULED	1.	0.3	19.52	19.52	0.0	19.52	19.52
MAINTENANCE DELAY - UNSCHEDULED	26.	8.7	375.48	14.44	25.29	97.67	0.03
LOADING DELAY - MANEUVERING	24.	8.0	47.42	1.98	2.05	9.47	0.13
LOADING DELAY - SCALING	2.	0.7	2.80	1.40	0.23	1.63	1.17
PLACE DELAY - BOLTER	1.	0.3	34.00	34.00	0.0	34.00	34.00
CLEAN UP DELAY	10.	3.3	10.28	1.03	0.70	2.78	0.28
VENTILATION	1.	0.3	25.35	25.35	0.0	25.35	25.35
IMMERING	1.	0.3	19.67	19.67	0.0	19.67	19.67
DUST DELAY/SPRAYING DOWN	7.	2.3	6.35	0.91	0.45	1.48	0.15
TAPPING BOTTOM/TOP	3.	1.0	9.82	3.27	2.19	5.15	0.20
SAFETY - OTHER	1.	0.3	9.48	9.48	0.0	9.48	9.48
SYSTEM - OTHER	1.	0.3	115.97	115.97	0.0	115.97	115.97
OPERATOR DELAY	40.	13.3	8.70	0.22	0.20	0.97	0.07
CONDITIONS - OTHER	1.	0.3	0.61	0.63	0.0	0.63	0.63
SHUTTLE CAR DELAY	7.	1.0	29.10	9.70	9.06	22.05	0.58
LOADING OUT OF PLACE	1.	0.3	2.00	2.00	0.0	2.00	2.00

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OVERALL SUMMARY FOR 3 DAYS

ACTIVITIES-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	3.	1.0	5.13	1.71	0.38	1.98	1.17
WAITING ON MAN TRIP IN	3.	1.0	31.26	10.42	3.08	14.12	6.57
MAN TRIP IN	3.	1.0	41.42	13.81	1.43	15.22	11.85
DISCHARGE STANDARD SC	62.	20.7	39.07	0.63	0.22	1.63	0.32
DISCHARGE OFF STANDARD SC	61.	20.3	38.70	0.63	0.18	1.46	0.37
ANY SC DISCHARGING	123.	41.0	77.77	0.63	0.20	1.63	0.32
NO SC AT DUMP	126.	42.0	1108.83	8.80	18.08	133.67	0.75
FACE TRIP OUT	1.	0.3	8.70	8.70	0.0	8.70	8.70
WAITING ON MAN TRIP OUT	3.	1.0	10.71	3.57	3.33	8.28	1.20
MAN TRIP OUT	3.	1.0	38.94	12.98	2.83	15.18	8.98
WAITING FOR CAGE AND TRIP OUT	3.	1.0	13.58	4.53	2.04	7.40	2.88

DELAYS-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CABLE HANDLING DELAY	1.	0.3	0.53	0.53	0.0	0.53	0.53
CLAMP DUMP AREA	1.	0.3	0.82	0.82	0.0	0.82	0.82
SECTION REFT DOWN-OTHER	7.	2.3	26.06	3.72	4.54	12.50	0.22
SECTION REFT DOWN-ROCK	1.	0.3	1.55	1.55	0.0	1.55	1.55
SHUTTLE CAP OPERATOR DELAY	4.	1.3	1.22	0.30	0.24	0.70	0.10
FEEDER DOWN-ROCK	5.	1.7	25.84	5.17	6.50	17.23	0.03
OTHER-SAFETY	1.	0.3	24.47	24.47	0.0	24.47	24.47
OTHER-SYSTEM	10.	3.3	2.57	0.26	0.18	0.78	0.13
DUMP MAN DELAY	5.	1.7	1.47	0.29	0.34	0.98	0.07

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OVERALL SUMMARY FOR 3 DAYS

ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	3.	1.0	5.49	1.83	0.12	1.98	1.68
WAITING FOR MAN TRIP IN	3.	1.0	52.12	17.37	6.96	25.17	8.27
MAN TRIP IN	3.	1.0	60.28	20.09	2.10	22.68	17.53
FACE TRIP IN	3.	1.0	26.21	8.74	3.85	14.07	5.12
MACHINE PREP/MAINTENANCE	1.	0.3	3.68	3.68	0.0	3.68	3.68
CUTTING	170.	56.7	95.74	0.56	0.36	2.42	0.05
LOADING STANDARD SHUTTLE CAR	73.	24.3	209.64	2.87	1.19	8.19	0.85
LOADING OFF-STANDARD SHUTTLE CAR	54.	18.0	175.41	3.25	1.27	7.20	1.11
LOADING AND/OR CUTTING	142.	47.3	389.64	2.74	1.45	8.19	0.07
WAITING FOR SHUTTLE CAR	141.	47.0	187.84	1.33	1.54	11.58	0.05
PREPARATION FOR PLACE CHANGE	6.	2.0	2.48	0.41	0.41	1.33	0.20
FORWARD TRAM	1.	0.3	2.51	2.53	0.0	2.53	2.53
MANEUVERING FOR TURN	7.	2.3	16.44	2.35	0.63	3.42	1.62
MANEUVERING TO NEXT CUT/FACE	2.	0.7	2.85	1.42	0.40	1.82	1.03
PREPARATION FOR DEPARTURE	3.	1.0	4.42	1.47	0.73	2.50	0.87
FACE TRIP OUT	3.	1.0	9.45	3.15	1.45	5.00	1.47
WAITING FOR MAN TRIP OUT	3.	1.0	19.08	6.36	4.47	12.00	1.08
MAN TRIP OUT	3.	1.0	54.13	18.04	1.38	20.00	17.00
WAITING ON CAGE AND TRIP OUT	3.	1.0	24.62	8.21	2.27	10.00	5.00
FORWARD TRAM - END	10.	3.3	23.27	2.33	2.13	6.58	0.02
REVERSE TRAM - BEGIN	8.	2.7	9.17	1.15	0.62	2.25	0.40

DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CARLE HANDLING DELAY	12.	4.0	21.48	1.79	2.18	6.53	0.08
INSPECTION AND PREPARATION	3.	1.0	5.06	1.69	0.08	1.77	1.57
MAINTENANCE DELAY - SCHEDULED	4.	1.3	74.17	18.54	11.75	30.90	3.70
MAINTENANCE DELAY - UNSCHEDULED	13.	4.3	270.92	20.84	58.85	223.05	0.07
LOADING DELAY - MANEUVERING	35.	11.7	57.52	1.64	1.03	5.83	0.07
RIT CHANGE	4.	1.3	13.08	3.27	1.78	4.88	0.32
PLACE DELAY - SCOOP	1.	0.3	3.98	3.98	0.0	3.98	3.98
TRAFFIC DELAY - ROLLER	2.	0.7	1.80	0.90	0.20	1.10	0.70
CLEAN UP DELAY	10.	3.3	12.62	1.26	0.69	2.82	0.58
VENTILATION	10.	3.3	29.61	2.96	1.91	5.55	0.35
TAKING ACTION/TOP	5.	1.7	5.59	1.12	0.47	1.88	0.57
SAFETY - OTHER	2.	0.7	2.75	1.38	1.29	2.67	0.08
SYSTEM - OTHER	1.	0.3	14.43	14.43	0.0	14.43	14.43
OPERATOR DELAY	31.	11.0	9.22	0.28	0.38	1.67	0.05
SHUTTLE CAR DELAY	5.	1.7	5.71	1.14	1.11	3.22	0.27

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OVERALL SUMMARY FOR 3 DAYS

ACTIVITIES-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	3.	1.0	5.49	1.83	0.12	1.98	1.68
WAITING ON MAN TRIP IN	3.	1.0	52.12	17.37	6.96	25.17	8.27
MAN TRIP IN	3.	1.0	60.28	20.09	2.10	22.68	17.53
FACE TRIP IN	1.	0.3	5.12	5.12	0.0	5.12	5.12
DISCHARGE STANDARD SC	73.	24.3	47.11	0.65	0.19	1.40	0.35
DISCHARGE OFF STANDARD SC	53.	17.7	35.61	0.67	0.19	1.31	0.34
ANY SC DISCHARGING	126.	42.0	82.72	0.66	0.19	1.40	0.34
NO SC AT DUMP	128.	42.7	1066.99	8.34	20.96	229.43	0.53
FACE TRIP OUT	1.	0.3	0.50	0.50	0.0	0.50	0.50
WAITING ON MAN TRIP OUT	3.	1.0	19.08	6.36	4.47	12.00	1.08
MAN TRIP OUT	3.	1.0	54.13	18.04	1.38	20.00	17.00
WAITING FOR CAGE AND TRIP OUT	3.	1.0	24.02	8.21	2.27	10.00	5.00

DELAYS-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
SECTION BELT DOWN-OTHER	7.	2.3	48.69	6.96	7.60	22.38	0.10
SHUTTLE CAR OPERATOR DELAY	2.	0.7	1.00	0.50	0.33	0.83	0.17
FEEDER OG N-ROCK	1.	0.3	1.03	1.03	0.0	1.03	1.03

## OVERALL SUMMA. FOR 3 DAYS

## ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN) LOW (MIN)
CAGE TRIP IN	3.	1.0	5.79	1.93	0.07	1.98 1.83
WAITING FOR M. TRIP IN	3.	1.0	33.93	11.31	4.97	18.33 7.60
MAN TRIP IN	3.	1.0	63.89	21.30	1.78	23.82 20.00
FACE TRIP IN	3.	1.0	24.55	8.18	1.14	9.00 6.57
MACHINE PREP/MAINTENANCE	1.	0.3	0.75	0.75	0.0	0.75 0.75
POSITIONING FOR NEW CUT	3.	1.0	1.03	0.34	0.17	0.58 0.20
CUTTING	274.	91.3	137.47	0.50	0.32	2.22 0.07
LOADING STANDARD SHUTTLE CAR	95.	31.7	129.58	1.36	0.37	3.31 0.82
LOADING OFF-STANDARD SHUTTLE CAR	101.	33.7	142.77	1.41	0.38	3.17 0.57
LOADING AND/OR CUTTING	230.	76.7	286.21	1.24	0.54	3.31 0.08
WAITING FOR SHUTTLE CAR	223.	74.3	327.15	1.47	2.58	31.30 0.03
PREPARATION FOR PLACE CHANGE	17.	5.7	5.97	0.35	0.34	1.50 0.03
FORWARD TRAM	10.	3.3	15.15	1.51	0.40	2.57 1.17
REVERSE TRAM	13.	4.3	19.82	1.52	0.47	2.67 0.65
MANEUVERING FOR TURN	13.	4.3	10.48	0.81	0.43	1.52 0.13
MANEUVERING TO NEXT CUT/FACE	6.	2.0	11.16	1.86	0.64	3.00 1.25
PREPARATION FOR DEPARTURE	2.	0.7	2.01	1.00	0.53	1.53 0.48
FACE TRIP OUT	3.	1.0	12.28	4.09	2.04	6.97 2.58
WAITING FOR MAN TRIP OUT	3.	1.0	15.57	5.19	3.49	10.00 1.80
MAN TRIP OUT	3.	1.0	48.62	16.21	1.43	17.42 14.20
WAITING ON CAGE AND TRIP OUT	3.	1.0	28.75	9.58	6.47	18.73 5.00
FORWARD TRAM - BEGIN	1.	0.3	1.08	1.08	0.0	1.08 1.08
FORWARD TRAM - END	16.	5.3	16.08	1.00	0.79	3.15 0.02
REVERSE TRAM - BEGIN	14.	4.7	11.56	0.83	0.47	1.90 0.08

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## DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN) LOW (MIN)
CABLE HANDLING DELAY	24.	8.0	24.73	1.03	1.08	4.02 0.08
INSPECTION AND PREPARATION	4.	1.3	11.92	2.98	2.69	6.58 0.33
MAINTENANCE DELAY - SCHEDULED	1.	0.3	5.35	5.35	0.0	5.35 5.35
MAINTENANCE DELAY - UNSCHEDULED	4.	1.3	232.12	58.03	44.18	106.15 8.87
LOADING DELAY - MANEUVERING	41.	13.7	33.54	0.82	0.78	3.83 0.03
RIT CHANGE	1.	0.3	2.48	2.48	0.0	2.48 2.48
TRAFFIC DELAY - ROLLER	3.	1.0	3.27	1.09	0.27	1.37 0.73
TRAMMING DELAY - OTHER	5.	1.7	1.34	0.27	0.19	0.57 0.07
VENTILATION	2.	0.7	3.96	1.98	0.20	2.18 1.78
TIMING	3.	1.0	7.66	2.55	0.60	3.40 2.03
DUST DELAY/SPRAYING DOWN	3.	1.0	1.46	0.49	0.45	1.12 0.17
TAKING BOTTOM/TOP	1.	0.3	0.60	0.60	0.0	0.60 0.60
MACHINE - OTHER	1.	0.3	0.12	0.12	0.0	0.12 0.12
SYSTEM - OTHER	1.	0.3	71.68	71.68	0.0	71.68 71.68
OPERATOR DELAY	33.	11.0	6.86	0.21	0.31	1.65 0.05
SHUTTLE CAR DELAY	18.	6.0	72.61	4.03	8.67	27.40 0.05

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OVERALL SUMMARY FOR 2 DAYS

ACTIVITIES-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	2.	1.0	3.81	1.90	0.07	1.98	1.83
WAITING ON MAN TRIP IN	2.	1.0	25.93	12.96	5.36	18.33	7.60
MAN TRIP IN	2.	1.0	43.89	21.95	1.88	23.82	20.07
DISCHARGE STANDARD SC	74.	37.0	46.15	0.62	0.20	1.55	0.04
DISCHARGE OFF STANDARD SC	72.	36.0	40.44	0.56	0.17	1.34	0.18
ANY SC DISCHARGING	146.	73.0	86.59	0.59	0.19	1.55	0.04
NO SC AT DUMP	148.	74.0	65.26	4.50	14.53	139.95	0.12
WAITING ON MAN TRIP OUT	2.	1.0	5.57	2.78	0.98	3.77	1.80
MAN TRIP OUT	2.	1.0	31.62	15.81	1.61	17.42	14.20
WAITING FOR CAGE AND TRIP OUT	2.	1.0	23.75	11.87	6.85	18.73	5.02

DELAYS-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CABLE HANDLING DELAY	1.	0.5	0.22	0.22	0.0	0.22	0.22
SECTION RFLY DOWN-OTHER	17.	8.5	11.88	0.70	0.65	2.35	0.08
SC DELAY-POSITIONING	1.	0.5	4.02	4.02	0.0	4.02	4.02
SHUTTLE CAR OPERATOR DELAY	23.	11.5	9.71	0.42	0.30	1.18	0.05
INSPECTING DUMP AREA	1.	0.5	0.15	0.15	0.0	0.15	0.15
FEEDER DOWN-ROCK	45.	22.5	20.14	0.45	0.48	2.53	0.05
OTHER-MACHINE	2.	1.0	12.00	6.00	2.05	8.05	3.95
OTHER-SYSTEM	1.	0.5	0.17	0.17	0.0	0.17	0.17

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OVERALL SUMMARY FOR 2 DAYS

ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	2.	1.0	3.66	1.83	0.15	1.98	1.68
WAITING FOR MAN TRIP IN	2.	1.0	38.00	19.00	7.42	26.42	11.58
MAN TRIP IN	2.	1.0	27.09	13.54	1.12	14.67	12.42
FACE TRIP IN	2.	1.0	49.76	24.88	8.25	33.13	16.63
MACHINE PREP/MAINTENANCE	2.	1.0	21.07	10.53	4.19	14.72	6.35
CUTTING	64.	32.0	49.18	0.77	0.42	2.00	0.10
LOADING STANDARD SHUTTLE CAR	42.	21.0	76.86	1.83	0.81	5.66	0.92
LOADING OFF-STANDARD SHUTTLE CAR	51.	25.5	98.05	1.92	0.83	5.06	0.64
LOADING AND/OR CUTTING	102.	51.0	184.05	1.80	0.89	5.66	0.10
WAITING FOR SHUTTLE CAR	99.	49.5	159.29	1.61	1.45	8.80	0.06
PREPARATION FOR PLACE CHANGE	5.	2.5	3.16	0.63	0.33	1.14	0.22
FORWARD TRAM	4.	2.0	7.99	2.00	0.32	2.30	1.56
REVERSE TRAM	4.	2.0	6.04	1.51	0.29	1.83	1.20
MANEUVERING FOR TURN	7.	3.5	10.35	1.48	0.56	2.10	0.28
MANEUVERING TO NEXT CUT/FACE	1.	0.5	1.99	1.99	0.0	1.99	1.99
PREPARATION FOR DEPARTURE	2.	1.0	2.00	1.00	0.98	1.98	0.02
FACE TRIP OUT	2.	1.0	10.56	5.28	2.60	7.88	2.68
WAITING FOR MAN TRIP OUT	2.	1.0	7.73	3.86	0.41	4.28	3.45
MAN TRIP OUT	2.	1.0	26.02	13.01	2.14	15.15	10.87
WAITING ON CAGE AND TRIP OUT	2.	1.0	26.11	13.05	0.33	13.38	12.73
FORWARD TRAM - END	9.	4.5	8.51	0.95	0.91	3.25	0.17
REVERSE TRAM - BEGIN	8.	4.0	11.56	1.44	1.25	4.58	0.50

DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CABLE HANDLING DELAY	11.	5.5	33.99	3.09	5.44	19.87	0.12
INSPECTION AND PREPARATION	5.	2.5	4.66	0.93	0.45	1.75	0.48
MAINTENANCE DELAY - UNSCHEDULED	8.	4.0	162.53	20.32	36.21	111.80	0.10
LOADING DELAY - MANEUVERING	17.	8.5	21.16	1.24	0.81	3.40	0.10
TRAFFIC DELAY - RAILER	5.	2.5	19.90	3.98	2.08	6.27	1.60
TRAFFIC DELAY - OTHER	1.	0.5	0.88	0.88	0.0	0.88	0.88
CLEAN UP DELAY	7.	3.5	6.60	0.94	0.40	1.55	0.47
VENTILATION	4.	2.0	47.14	11.78	12.43	31.80	1.30
DUST DELAY/SPRAYING DOWN	1.	0.5	0.45	0.45	0.0	0.45	0.45
TAKING BOTTOM/TOP	5.	2.5	5.51	1.10	0.36	1.65	0.73
SAFETY - OTHER	1.	0.5	0.35	0.35	0.0	0.35	0.35
OPERATOR DELAY	16.	8.0	4.88	0.30	0.32	1.18	0.05
CONDITIONS - OTHER	2.	1.0	5.20	2.60	2.32	4.92	0.28
SHUTTLE CAR DELAY	2.	1.0	21.18	10.59	10.49	21.08	0.10

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OVERALL SUMMARY FOR 2 DAYS

ACTIVITIES-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	2.	1.0	3.66	1.83	0.15	1.98	1.68
WAITING ON MAN TRIP IN	2.	1.0	38.00	19.00	7.42	26.42	11.58
MAN TRIP IN	2.	1.0	27.09	13.54	1.12	14.67	12.42
FACE TRIP IN	1.	0.5	21.67	21.67	0.0	21.67	21.67
DISCHARGE STANDARD SC	41.	20.5	51.25	1.25	0.38	2.85	0.77
DISCHARGE OFF STANDARD SC	50.	25.0	55.52	1.11	0.27	2.07	0.14
ANY SC DISCHARGING	91.	45.5	106.77	1.17	0.33	2.85	0.14
NO SC AT PUMP	92.	46.0	556.28	6.05	10.95	70.92	0.28
FACE TRIP OUT	1.	0.5	2.03	2.03	0.0	2.03	2.03
WAITING ON MAN TRIP OUT	2.	1.0	7.73	3.86	0.41	4.28	3.45
MAN TRIP OUT	2.	1.0	26.02	13.01	2.14	15.15	10.87
WAITING FOR CAGE AND TRIP OUT	2.	1.0	26.11	13.05	0.33	13.38	12.73

DELAYS-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CABLE HANDLING DELAY	1.	0.5	104.75	104.75	0.0	104.75	104.75
SC MAINTENANCE DELAY-UNSCHEDULED	1.	0.5	3.82	3.82	0.0	3.82	3.82
SECTION BELT DOWN-OTHER	1.	0.5	2.00	2.00	0.0	2.00	2.00
SECTION BELT DOWN-ROCK	2.	1.0	7.37	3.68	0.46	4.15	3.22
SC DELAY-POSITIONING	33.	16.5	5.08	0.15	0.10	0.62	0.07
SHUTTLE CAR OPERATOR DELAY	1.	0.5	0.57	0.57	0.0	0.57	0.57
SC DELAY-TRAFFIC	1.	0.5	0.58	0.58	0.0	0.58	0.58

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Freeman United Coal Company

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Continuous Miner Source Data  
Dump Source Data

## OVERALL SUMMARY

ON 3 DAYS

## ACTIVITIES-CONT. MINCH

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	6	1.0	5.96	1.92	0.01	2.00	1.98
WAITING FOR MAN TRIP IN		1.0	29.65	9.88	2.98	13.25	6.00
MAN TRIP IN		1.0	41.49	13.90	1.57	16.00	12.22
FACE TRIP IN		1.0	24.03	8.01	0.27	8.35	7.68
MACHINE PREP/MAINTENANCE		0.7	20.38	10.19	9.66	19.85	0.53
CUTTING	174.	58.0	85.64	0.49	0.31	2.80	0.05
LOADING STANDARD SHUTTLE CAR	102.	34.0	125.32	1.23	0.70	6.20	0.30
LOADING OFF-STANDARD SHUTTLE CAR	103.	34.3	127.76	1.24	0.53	3.74	0.20
LOADING OTHER SHUTTLE CAR	99.	33.0	120.66	1.22	0.57	4.98	0.29
LOADING AND/OR CUTTING	319.	106.3	381.39	1.20	0.62	6.20	0.05
WAITING FOR SHUTTLE CAR	309.	103.0	346.68	1.12	1.74	13.73	0.05
PREPARATION FOR PLACE CHANGE	19.	6.3	4.74	0.25	0.19	0.87	0.05
FORWARD TRAM	7.	2.3	11.67	1.67	1.02	3.90	0.78
REVERSE TRAM	6.	2.0	6.37	1.06	0.54	2.13	0.53
MANEUVERING FOR TURN	11.	3.7	10.72	3.97	0.81	2.57	0.02
MANEUVERING TO NEXT CUT/FACE	9.	3.0	14.62	1.62	0.83	2.77	0.33
PREPARATION FOR DEPARTURE	3.	1.0	5.69	1.90	1.34	3.45	0.17
FACE TRIP OUT	3.	1.0	29.53	9.84	6.37	18.63	3.73
WAITING FOR MAN TRIP OUT	3.	1.0	24.80	8.27	4.26	11.42	2.25
MAN TRIP OUT	3.	1.0	40.53	13.51	1.47	15.53	12.08
WAITING ON CAGE AND TRIP OUT	3.	1.0	21.17	7.06	2.45	10.37	4.52
FORWARD TRAM - END	13.	4.3	17.43	1.34	1.44	4.85	0.05
REVERSE TRAM - BEGIN	12.	4.0	8.11	0.68	0.32	2.00	0.02

## DELAYS-CONT. MINCH

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CABLE HANDLING DELAY	8.	2.7	20.94	2.62	4.34	13.63	0.23
INSPECTION AND PREPARATION	3.	1.0	1.54	2.51	0.26	0.88	0.33
SECTION POWER	5.	1.7	23.57	4.71	5.26	15.20	1.42
MAINTENANCE DELAY - SCHEDULED	1.	0.3	4.35	9.38	0.0	9.38	9.38
MAINTENANCE DELAY - UNSCHEDULED	2.	0.7	4.65	2.32	0.48	2.80	1.85
LOADING DELAY - MANEUVERING	28.	9.3	14.50	0.70	0.73	3.33	0.07
TRAFFIC DELAY - MINUTE	1.	0.3	0.45	0.45	0.0	0.85	0.05
CLEAN UP DELAY	8.	2.7	21.65	2.71	3.13	9.22	0.18
TRAMMING DELAY - OTHER	7.	2.3	9.41	1.34	1.31	4.32	0.38
TURNING	5.	1.7	27.67	5.53	2.02	7.73	2.22
DUST DELAY/SPRAYING DOWN	14.	4.7	8.94	0.64	0.61	2.43	0.19
TAKING MOTOR/TOP	3.	1.0	4.67	1.56	0.97	2.42	0.20
SAFETY - OTHER	4.	1.3	1.43	0.36	0.22	0.68	0.12
SYSTEM - OTHER	4.	1.3	10.20	2.55	2.88	7.27	0.07
OPERATION DELAY	6.	4.7	5.06	0.19	0.17	0.78	0.05
CONDITIONS - OTHER	7.	2.3	14.14	2.03	1.67	5.22	0.12
CABLE REPAIR	5.	1.7	11.53	26.31	15.79	49.98	0.85
SHUTTLE CAR DELAY	11.	3.7	27.11	2.36	2.31	6.93	0.25
LOADING OUT OF PLACE	5.	1.7	18.45	3.79	2.17	6.63	1.38

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# OVER-ALL SUMMARY FOR 3 DAYS

## ACTIVITIES-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	3.	1.0	5.96	1.99	0.01	2.00	1.98
WAITING ON MAN TRIP IN	3.	1.0	29.65	9.88	2.98	13.25	6.00
MAN TRIP IN	3.	1.0	41.69	13.90	1.57	16.00	12.22
FACE TRIP IN	2.	0.7	20.80	10.40	2.05	12.45	8.35
DISCHARGE STANDARD SC	94.	31.3	123.66	1.32	0.53	4.93	0.60
DISCHARGE OFF STANDARD SC	94.	32.7	122.03	1.25	0.40	2.52	0.40
DISCHARGE OTHER SC	100.	33.3	179.80	1.80	0.69	5.86	0.33
DUAL DISCHARGE STANDARD SC	5.	1.7	17.35	3.47	1.13	4.80	2.00
DUAL DISCHARGE OFF STANDARD SC	4.	1.3	9.49	2.37	0.41	2.72	1.71
PIGGYBACK DISCHARGE STANDARD SC	4.	1.3	6.45	1.61	0.43	2.10	1.14
PIGGYBACK DISCHARGE OFF STD SC	5.	1.7	9.01	1.80	0.80	3.02	0.82
PARTIAL DISCHARGE SC	1.	0.3	1.00	1.00	0.0	1.00	1.00
ANY SC DISCHARGING	214.	73.0	413.19	1.89	1.30	9.48	0.33
NO SC AT DUMP	216.	72.0	646.58	2.99	7.28	67.70	0.03
FACE TRIP OUT	1.	0.3	5.53	5.53	0.0	5.53	5.53
WAITING ON MAN TRIP OUT	3.	1.0	14.67	4.89	4.65	11.42	1.00
MAN TRIP OUT	3.	1.0	40.53	13.51	1.47	15.53	12.08
WAITING FOR CAGE AND TRIP OUT	3.	1.0	21.17	7.06	2.45	10.37	4.52

## DELAYS-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
SECTION POWER	1.	0.3	2.17	2.17	0.0	2.17	2.17
SC MAINTENANCE DELAY-UNSCHEMULED	1.	0.3	0.10	0.10	0.0	0.10	0.10
SECTION HELT DOWN-OTHER	41.	13.7	151.31	3.69	3.89	18.17	0.03
HELT OVERLOAD/MOVE NEW CAR UP	12.	4.0	8.86	0.74	0.44	1.77	0.18
SECTION HELT DOWN-ROCK	1.	0.3	0.30	0.30	0.0	0.30	0.30
SHUTTLE CAR OPERATOR DELAY	24.	8.0	11.90	0.50	0.89	4.32	0.05
SC DELAY-Traffic	2.	0.7	0.72	0.36	0.14	0.50	0.22
INSPECTING DUMP AREA	1.	0.3	1.08	1.08	0.0	1.08	1.08

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ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	RANGE LOW (MIN)
CAGE TRIP IN	3.	1.0	5.76	1.99	0.01	2.00	1.99
WAITING FOR MAN TRIP IN	3.	1.0	44.82	14.94	6.96	24.55	8.27
MAN TRIP IN	3.	1.0	38.46	12.82	1.98	14.83	10.13
FACE TRIP IN	3.	1.0	15.44	5.29	3.85	9.90	0.48
MACHINE PRE/MAINTENANCE	3.	1.0	13.67	4.56	2.76	8.20	1.52
CUTTING	329.	109.7	187.16	0.57	0.29	2.77	0.03
LOADING STANDARD SHUTTLE CAR	124.	42.7	154.15	1.24	0.50	3.69	0.52
LOADING OFF-STANDARD SHUTTLE CAR	151.	51.0	184.20	1.20	0.51	3.76	0.31
LOADING OTHER SHUTTLE CAR	109.	36.3	127.79	1.17	0.38	2.54	0.20
LOADING AND/OR CUTTING	405.	135.0	487.21	1.20	0.51	3.76	0.03
WAITING FOR SHUTTLE CAR	392.	130.7	335.77	0.86	2.91	53.06	0.07
PREPARATION FOR PLACE CHANGE	27.	9.0	13.47	0.50	0.45	2.17	0.07
FORWARD TRAM	4.	1.3	4.19	1.05	0.58	1.97	0.47
REVERSE TRAM	5.	1.7	5.45	1.09	0.25	1.40	0.65
MANEUVERING FOR TURN	12.	4.0	8.62	0.72	0.38	1.39	0.13
MANEUVERING TO NEXT CUT/FACE	17.	5.7	20.65	1.21	0.65	2.13	0.12
PREPARATION FOR DEPARTURE	3.	1.0	5.16	1.72	0.58	2.47	1.07
FACE TRIP OUT	3.	1.0	66.33	22.11	0.29	22.52	21.88
WAITING FOR MAN TRIP OUT	3.	1.0	9.76	3.25	0.97	4.62	2.47
MAN TRIP OUT	3.	1.0	34.05	11.35	1.39	13.25	9.97
WAITING ON CAGE AND TRIP OUT	3.	1.0	27.12	9.04	3.15	11.50	4.60
FORWARD TRAM - BEGIN	1.	0.3	0.32	0.32	0.0	0.32	0.32
FORWARD TRAM - END	14.	4.7	28.95	2.07	2.63	10.00	0.08
REVERSE TRAM - BEGIN	12.	4.0	7.73	0.64	0.46	1.83	0.18

DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	RANGE LOW (MIN)
CABLE HANDLING DELAY	4.	2.7	15.09	1.49	1.45	5.50	0.12
INSPECTION AND PREPARATION	17.	5.7	8.89	0.52	0.36	1.42	0.10
MAINTENANCE DELAY - SCHEDULED	3.	1.0	31.19	10.40	6.90	16.97	0.87
MAINTENANCE DELAY - UNSCHEDULED	9.	3.0	31.07	3.45	9.03	29.00	0.07
LOADING DELAY - MANEUVERING	24.	8.0	15.05	0.63	0.59	2.52	0.08
HIT CHANGE	3.	1.0	2.54	0.85	0.59	1.50	0.07
CLEAN UP DELAY	2.	0.7	17.29	8.60	1.18	9.78	7.42
TRAMMING DELAY - OTHER	3.	1.0	6.44	2.16	1.61	4.15	0.20
VENTILATION	2.	0.7	3.00	1.50	0.92	2.42	0.58
TIMBERING	1.	0.3	5.60	5.60	0.0	5.60	5.60
DUST DELAY/SQUAYING DOWN	10.	3.3	44.33	4.43	4.20	14.77	0.37
TAKING BOTTOM/UP	14.	4.7	6.06	0.43	0.26	0.90	0.07
SAFETY - OTHER	1.	0.3	0.44	0.44	0.0	0.44	0.44
MACHINE - OTHER	3.	1.0	6.11	2.04	1.05	3.05	0.60
SYSTEM - OTHER	1.	0.3	1.28	1.28	0.0	1.28	1.28
OPERATOR DELAY	2.	0.7	5.87	2.93	2.81	5.75	0.12
CONDITIONS - OTHER	50.	16.7	8.63	0.17	0.16	0.94	0.05
SHUTTLE CAR DELAY	11.	4.1	21.54	1.96	1.44	5.58	0.27
PREPARATION DELAY	24.	8.7	6.34	0.24	0.51	2.72	0.05
MANEUVERING DELAY	2.	0.7	9.96	4.98	4.30	9.24	0.68

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OVERALL SUMMARY FOR 3 DAYS

ACTIVITIES-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	3	1.0	5.26	1.92	0.01	2.00	1.98
WAITING ON MAN TRIP IN	3	1.0	44.82	14.94	6.96	24.55	8.27
MAN TRIP IN	3	1.0	38.46	12.82	1.98	14.83	10.13
FACE TRIP IN	1	0.3	9.90	9.90	0.0	9.90	9.90
PREPARATION	1	0.3	6.42	6.42	0.0	6.42	6.42
DISCHARGE STANDARD SC	130	43.3	144.05	1.11	0.24	2.10	0.62
DISCHARGE OFF STANDARD SC	154	51.3	160.21	1.04	0.24	2.30	0.31
DISCHARGE OTHER SC	110	36.7	143.99	1.31	0.37	2.71	0.05
ANY SC DISCHARGING	314	104.7	431.17	1.37	0.88	11.54	0.30
NO SC AT DUMP	317	105.7	630.81	1.99	3.66	25.50	0.04
WAITING ON MAN TRIP OUT	3	1.0	9.76	3.25	0.97	4.62	2.47
MAN TRIP OUT	3	1.0	34.05	11.35	1.39	13.25	9.97
WAITING FOR CAGE AND TRIP OUT	3	1.0	27.12	9.04	3.15	11.50	4.60

DELAYS-DUMP

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CLEANUP DUMP AREA	1	0.3	10.97	10.97	0.0	10.97	10.97
SECTION RFTL DOWN-OTHER	23	7.7	134.96	5.87	10.83	53.71	0.30
HELT OVERLOAD/MOVE NEW CAR UP	15	5.0	12.93	0.86	0.45	1.59	0.15
SC DELAY-POSITIONING	1	0.3	0.80	0.80	0.0	0.80	0.80
SHUTTLE CAR OPERATOR DELAY	66	22.0	19.77	0.30	1.17	4.53	0.05
SC DELAY-SUPPLIES	1	0.3	9.10	0.10	0.0	0.10	0.10
OTHER-SYSTEM	6	2.0	27.30	4.55	8.57	23.70	0.28
TURN ON/OFF WATER	1	0.3	0.77	0.77	0.0	0.77	0.77

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OF POOR QUALITY

OVERALL SUMMARY FOR 2 DAYS

ACTIVITIES-COLL. AREA

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	RANGE LOW (MIN)
CAGE TIME IN	2	1.0	3.28	1.92	0.81	2.00	1.98
WAITING FOR AND TIE IN	2	1.0	0.90	0.45	0.24	0.73	0.17
MAN TIE IN	2	1.0	34.53	17.26	7.76	27.03	11.50
FACE TIE IN	2	1.0	23.90	11.95	0.93	12.63	10.77
ACQUIRE REFLECTIONS	2	1.0	0.76	0.38	0.10	0.48	0.28
POSITIONING FOR NEW CUT	3	1.5	0.81	0.27	0.18	0.52	0.12
CUTTING	159	12.5	86.14	0.54	0.22	1.82	0.04
LOADING STANDARD SHUTTLE CAR	64	34.0	96.14	1.41	0.49	2.85	0.72
LOADING OFF-STANDARD SHUTTLE CAR	83	41.5	109.24	1.32	0.59	4.00	0.53
LOADING OTHER SHUTTLE CAR	58	23.0	75.27	1.30	0.57	4.83	0.56
LOADING AND/OR CUTTING	214	107.0	288.48	1.35	0.72	7.17	0.04
WAITING FOR SHUTTLE CAR	204	102.0	261.67	1.28	0.88	52.85	0.03
PREPARATION FOR PLACE CHANGE	16	8.0	7.12	0.44	0.33	1.02	0.07
FORWARD TEAM	4	2.0	8.03	2.01	0.66	2.68	0.97
REVERSE TEAM	5	2.5	6.07	1.21	0.62	2.05	0.33
MANEUVERING FOR TURN	6	3.0	3.95	0.66	0.42	1.49	0.02
ADJUSTING TO NEW CUT/FACE	9	4.5	11.27	1.25	1.13	4.15	0.25
PREPARATION FOR DEPARTURE	2	1.0	2.82	1.41	0.24	1.65	1.17
FACE TIE IN	2	1.0	12.76	6.38	0.80	7.18	5.58
WAITING FOR AND TIE OUT	2	1.0	12.28	6.14	1.14	7.28	5.00
MAN TIE OUT	2	1.0	23.10	11.55	1.47	13.02	10.08
WAITING FOR CAGE AND TIE IN	2	1.0	9.77	4.89	2.63	7.52	2.25
FORWARD TEAM - TIE IN	1	0.5	0.35	0.35	0.0	0.35	0.35
FORWARD TEAM - TIE OUT	4	4.0	10.35	1.29	1.46	4.39	0.02
REVERSE TEAM - TIE IN	7	3.5	9.01	0.86	0.83	2.35	0.10

DELAYS-COLL. AREA

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	RANGE LOW (MIN)
CAGE TIME IN DELAY	7	3.5	14.56	2.08	0.83	8.43	0.27
WAITING FOR AND TIE IN DELAY	4	2.0	1.31	0.33	0.49	1.13	0.03
MAN TIE IN DELAY	13	12.5	13.77	0.57	0.53	2.15	0.07
FACE TIE IN DELAY	1	1.5	0.44	0.16	0.04	0.20	0.10
ACQUIRE REFLECTIONS DELAY	1	0.5	37.40	37.40	0.0	37.40	37.40
POSITIONING FOR NEW CUT DELAY	2	1.0	1.17	0.58	0.32	0.97	0.20
CUTTING DELAY	6	3.0	99.28	6.71	4.07	14.57	1.57
LOADING STANDARD SHUTTLE CAR DELAY	1	0.5	12.10	12.10	0.0	12.10	12.10
LOADING OFF-STANDARD SHUTTLE CAR DELAY	2	1.0	1.23	0.61	0.14	0.73	0.07
LOADING OTHER SHUTTLE CAR DELAY	1	0.5	0.20	0.20	0.0	0.20	0.20
LOADING AND/OR CUTTING DELAY	2	1.0	10.30	5.15	0.54	1.93	0.03
WAITING FOR SHUTTLE CAR DELAY	1	0.5	1.27	0.63	0.0	1.27	1.27
PREPARATION FOR PLACE CHANGE DELAY	1	0.5	17.23	17.23	0.0	17.23	17.23
FORWARD TEAM DELAY	2	1.0	1.10	0.55	0.27	0.73	0.07
REVERSE TEAM DELAY	6	3.0	2.70	0.45	0.70	0.17	1.25

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9950-601

OVERALL SUMMARY FOR 2 DAYS

ACTIVITY-S-DUMP

ACTIVITY	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	HIGH (MIN)	LOW (MIN)
CARTRIDGE IN	2	1.0	1.94	1.99	0.01	2.00	1.98
WAITING ON MAIN TRIP IN	2	1.0	4.90	4.45	0.24	4.73	4.17
MAIN TRIP IN	2	1.0	34.53	19.26	7.76	27.03	11.50
DISCHARGE STANDARD SC	72	36.0	106.18	1.48	0.25	2.18	0.49
DISCHARGE OFF STANDARD SC	84	44.0	111.13	1.26	0.25	1.83	0.35
DISCHARGE OTHER SC	59	29.5	64.88	1.17	0.16	1.48	0.73
ANY SC DISCHARGING	201	100.5	278.75	1.39	0.46	1.72	0.35
NO SC AT DUMP	201	100.5	448.49	2.23	4.28	40.80	0.06
WAITING ON MAIN TRIP OUT	2	1.0	12.24	6.14	1.14	7.28	5.00
MAIN TRIP OUT	2	1.0	23.10	11.55	1.47	13.02	10.08
WAITING FOR CARTRIDGE AND TRIP OUT	2	1.0	9.77	4.89	2.63	7.52	2.25

DELAYS-DUMP

ACTIVITY	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	HIGH (MIN)	LOW (MIN)
CLEARING DUMP AREA	2	1.0	1.14	0.59	0.39	0.94	0.20
SECURITY BELT UNLATCHING	10	5.0	18.04	1.80	1.34	4.77	0.15
MAIN BELT DUMP/CAR OFF TRUCK	1	0.5	68.14	68.14	0.0	68.14	68.14
BELT OVERLOAD/STOP WHEN CAR UP	7	3.5	4.05	0.58	0.41	1.12	0.10
SHUTTLE CAR OPERATOR DELAY	100	50.0	17.17	0.18	0.14	0.55	0.03
INSPECTION DUMP AREA	1	1.0	1.56	0.52	0.08	0.63	0.45
LUNCH	1	0.5	1.84	1.84	0.0	1.84	1.84



OVERALL SUMMARY FOR 2 DAYS

ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	2.	1.0	11.13	5.56	3.59	9.15	1.98
WAIT'NG FOR MAN TRIP IN	2.	1.0	18.00	9.00	3.50	12.50	5.50
MAN TRIP IN	2.	1.0	26.23	12.11	1.98	14.10	10.13
FACE TRIP IN	2.	1.0	21.95	10.97	0.51	11.98	10.47
MACHINE PREP/MAINTENANCE	1.	0.5	3.52	3.52	0.0	3.52	3.52
CUTTING	27.	13.5	21.24	0.79	0.41	1.50	0.15
LOADING STANDARD SHUTTLE CAR	74.	37.0	129.72	1.75	0.71	4.36	0.62
LOADING OFF-STANDARD SHUTTLE CAR	56.	28.0	90.67	1.62	0.62	3.96	0.82
LOADING AND/OR CUTTING	136.	68.0	227.38	1.67	0.74	4.60	0.31
WAITING FOR SHUTTLE CAR	133.	66.5	277.71	2.09	3.14	27.45	0.15
PREPARATION FOR PLACE CHANGE	8.	4.0	5.13	0.64	0.52	1.55	0.07
FORWARD TRAM	7.	3.5	9.78	1.40	0.59	2.65	0.70
REVERSE TRAM	7.	3.5	16.31	2.04	1.82	6.10	0.70
MANEUVERING FOR TURN	8.	4.0	8.96	1.12	0.54	2.07	0.02
MANEUVERING TO NEXT CUT/FACE	1.	0.5	1.33	1.33	0.0	1.33	1.33
PREPARATION FOR DEPARTURE	1.	0.5	3.78	3.78	0.0	3.78	3.78
FACE TRIP OUT	2.	1.0	17.73	8.86	3.89	12.75	4.98
WAITING FOR MAN TRIP OUT	2.	1.0	6.23	4.11	3.22	7.33	0.90
MAN TRIP OUT	2.	1.0	16.89	8.44	0.43	8.87	8.02
WAITING ON CAGE AND TRIP OUT	2.	1.0	17.68	8.84	1.64	10.48	7.20
FORWARD TRAM - END	10.	5.0	12.57	1.26	0.64	3.03	0.68
REVERSE TRAM - BEGIN	8.	4.0	7.77	0.97	0.95	3.21	0.08

DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CABLE HANDLING DELAY	10.	5.0	10.09	1.01	0.76	2.85	0.13
INSPECTION AND PREPARATION	4.	2.0	4.63	1.16	0.54	1.93	0.42
SECTION POWER	1.	0.5	1.47	1.47	0.0	1.47	1.47
MAINTENANCE DELAY - SCHEDULED	3.	1.5	94.55	31.52	10.57	43.68	17.92
MAINTENANCE DELAY - UNSCHEDULED	8.	4.0	62.73	7.84	8.26	23.43	0.93
LOADING DELAY - MANEUVERING	5.	2.5	7.65	1.53	1.10	3.60	0.45
LOADING DELAY - SCALING	1.	0.5	12.23	12.23	0.0	12.23	12.23
RIT CHANGE	2.	1.0	10.90	5.45	0.75	6.20	4.70
TRAFFIC DELAY - HOLLER	2.	1.0	1.85	0.92	0.44	1.37	0.48
CLEAN UP DELAY	2.	1.0	2.98	1.49	1.06	2.55	0.43
VENTILATION	4.	2.0	8.02	2.00	1.46	4.47	0.67
TAKING PULLDOWN/UP	1.	0.5	2.15	2.15	0.0	2.15	2.15
SAFETY - OTHER	2.	1.0	8.39	4.19	2.98	7.17	1.22
OPERATOR DELAY	13.	6.5	9.56	0.74	1.94	7.43	0.08
SHUTTLE CAR DELAY	1.	0.5	4.12	0.12	0.0	0.12	0.12
LOADING OUT OF PLACE	1.	0.5	7.35	7.35	0.0	7.35	7.35

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## OVERALL SUMMARY FOR 2 DAYS

## ACTIVITIES-DUMP

	FREQ.	AVG. DAILY FREQUENCY	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CAGE TRIP IN	2	1.0	11.13	5.56	1.54	9.15	1.98
WAITING ON MAN TRIP IN	2	1.0	18.00	9.00	3.50	12.50	5.50
MAN TRIP IN	2	1.0	24.23	12.11	1.98	14.10	10.13
DISCHARGE STANDARD SC	72	36.0	60.39	0.92	0.15	1.67	0.62
DISCHARGE OFF STANDARD SC	56	28.0	66.30	1.18	0.27	2.16	0.73
ANY SC DISCHARGING	115	57.5	123.61	1.07	0.31	2.88	0.62
NO SC AT JUMP	116	58.0	636.09	5.48	10.75	89.95	0.07
WAITING ON MAN TRIP OUT	2	1.0	8.23	4.11	3.22	7.33	0.90
MAN TRIP OUT	2	1.0	16.89	8.44	0.43	8.87	8.02
WAITING FOR CAGE AND TRIP OUT	2	1.0	17.68	8.84	1.64	10.58	7.20

## DELAYS-DUMP

	FREQ.	AVG. DAILY FREQUENCY	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
SECTION BELT DOWN-OTHER	12	6.0	95.80	7.98	6.80	25.18	0.97
SC DELAY-POSITIONING	7	1.0	0.42	0.21	0.01	0.22	0.20
SHUTTLE CAR OPERATOR DELAY	1	1.5	0.78	0.26	0.12	0.43	0.15

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Appalachian Regional Commission

Continuous Miner Source Data

# OVERALL SUMMARY FOR 4 DAYS

## ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	RANGE LOW (MIN)
MAN TRIP IN	4.	1.0	98.53	24.63	3.55	29.98	19.98
FACE TRIP IN	4.	1.0	44.19	11.05	3.49	16.30	6.52
MACHINE PREP/MAINTENANCE	3.	0.8	79.11	26.37	15.95	41.34	4.27
POSITIONING FOR NEW CUT	2.	0.5	1.27	0.63	0.46	1.10	0.17
CUTTING	86.	21.5	163.42	1.90	2.29	14.40	0.08
LOADING STANDARD SHUTTLE CAR	104.	26.0	202.35	1.95	0.68	4.17	0.92
LOADING AND/OR CUTTING	95.	23.8	190.31	2.01	1.15	10.85	0.87
WAITING FOR SHUTTLE CAR	196.	49.0	432.01	2.20	1.72	16.13	0.10
PREPARATION FOR PLACE CHANGE	188.	47.0	315.22	1.68	0.60	13.25	0.07
FORWARD TRAM	11.	2.8	7.27	0.66	0.56	2.00	0.05
REVERSE TRAM	5.	1.3	6.38	1.28	0.23	1.65	0.95
MANEUVERING FOR TURN	7.	1.8	11.11	1.59	0.56	2.68	1.03
MANEUVERING TO NEXT CUT/FACE	10.	2.5	11.37	1.14	0.47	2.25	0.62
PREPARATION FOR DEPARTURE	2.	0.5	1.05	0.52	0.33	0.85	0.20
FACE TRIP OUT	1.	0.3	2.27	2.27	0.0	2.27	2.27
WAITING FOR MAN TRIP OUT	4.	1.0	13.30	3.32	4.10	10.40	0.32
MAN TRIP OUT	4.	1.0	21.45	5.36	2.51	9.45	2.63
FORWARD TRAM - END	4.	1.0	105.94	26.49	2.24	25.72	23.48
REVERSE TRAM - BEGIN	14.	3.5	17.31	1.24	1.12	4.38	0.13
	10.	2.5	12.55	1.25	0.60	2.65	0.57

## DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	RANGE LOW (MIN)
CABLE HANDLING DELAY	17.	4.3	26.14	1.54	1.60	6.05	0.08
SECTION POWER	2.	0.5	3.48	1.74	1.06	2.80	0.68
SECTION WATER	2.	0.5	38.02	19.01	0.09	19.10	18.92
MAINTENANCE DELAY - SCHEDULED	2.	0.5	4.10	2.05	0.07	2.12	1.98
MAINTENANCE DELAY - UNSCHEDULED	5.	1.3	77.06	15.41	27.97	71.22	0.17
LOADING DELAY - MANEUVERING	34.	8.5	23.62	0.69	0.40	2.03	0.18
RIT CHANGE	1.	0.3	7.03	7.03	0.0	7.03	7.03
PLACE DELAY - BOLTER	1.	0.3	5.75	5.75	0.0	5.75	5.75
TRAFFIC DELAY - BOLTER	4.	1.0	5.48	1.37	0.30	1.83	0.98
CLEAN UP DELAY	21.	5.3	21.38	1.02	1.64	8.18	0.15
VENTILATION	3.	0.8	76.89	25.63	33.10	72.42	0.90
YIBBERING	13.	3.3	62.69	4.82	2.32	8.71	0.85
DUST DELAY/SPRAYING DOWN	1.	0.3	0.17	0.17	0.0	0.17	0.17
LUNCH	2.	0.5	72.20	36.10	2.87	38.97	0.23
SYSTEM - OTHER	6.	1.5	21.16	3.53	3.23	12.17	0.28
OPERATOR DELAY	11.	2.8	4.25	0.39	0.34	1.15	0.03
SHUTTLE CAR DELAY	10.	2.5	3.32	0.33	0.21	0.83	0.10
LOADING OUT OF PLACE	2.	0.5	25.52	12.76	9.06	21.82	3.70

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OVERALL SUMMARY 5 DAYS

ACTIVITIES-CONT. MINED

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	RANGE LOW (MIN)
MAN TRIP IN	5.	1.0	146.05	29.21	2.93	33.98	24.98
FACE TRIP IN	5.	1.0	49.48	9.90	5.78	20.80	4.33
MACHINE PREP/MAINT. M.C.	5.	1.0	129.00	25.80	6.80	36.37	17.88
POSITIONING FOR NEW CUT	1.	0.2	0.32	0.32	0.0	0.32	0.06
CUTTING	119.	23.8	83.14	0.70	0.43	2.20	0.06
LOADING STANDARD SHUTTLE CAR	84.	16.8	150.69	1.89	0.69	4.01	0.77
LOADING OFF-STANDARD SHUTTLE CAR	115.	23.0	190.75	1.66	0.71	4.41	0.03
LOADING AND/OR CUTTING	201.	40.6	354.65	1.75	0.73	4.41	0.03
WAITING FOR SHUTTLE CAR	199.	39.8	527.19	2.65	3.11	27.93	0.12
PREPARATION FOR PLACE CHANGE	10.	2.0	7.64	0.78	0.36	1.65	0.25
FORWARD TRAM	8.	1.6	6.25	0.78	0.25	1.11	0.27
REVERSE TRAM	11.	2.2	14.72	1.34	1.38	5.53	0.10
MANEUVERING FOR TURN	10.	2.0	12.27	1.23	0.94	3.77	0.57
PREPARATION FOR DEPARTURE	3.	0.6	6.43	2.14	1.51	4.03	0.33
FACE TRIP OUT	5.	1.0	12.03	2.41	1.01	4.27	1.42
WAITING FOR MAN TRIP OUT	5.	1.0	43.31	8.66	8.96	26.48	2.65
MAN TRIP OUT	5.	1.0	135.43	27.09	2.26	29.98	23.30
FORWARD TRAM - END	15.	3.0	24.39	1.63	1.49	5.04	0.08
REVERSE TRAM - BEGIN	10.	2.0	9.29	0.93	1.24	4.25	0.07

DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	RANGE LOW (MIN)
CARL HANDLING DELAY	16.	3.2	8.57	0.54	0.48	1.72	0.08
INSPECTION AND PREPARATION	2.	0.4	0.95	0.48	0.38	0.85	0.10
SECTION POWER	1.	0.2	18.13	18.13	0.0	18.13	18.13
MAINTENANCE DELAY - SCHEDULED	1.	0.2	5.95	5.95	0.0	5.95	5.95
MAINTENANCE DELAY - UNSCHEDULED	14.	2.8	155.64	11.12	14.73	38.15	0.10
LOADING DELAY - MANEUVERING	23.	4.6	16.97	0.74	0.55	2.52	0.22
LOADING DELAY - SCALING	2.	0.4	1.50	0.75	0.10	0.85	0.65
PLACE DELAY - HOLTER	3.	0.6	147.20	49.07	49.10	118.05	7.75
TRAFIC DELAY - HOLTER	6.	1.2	22.10	3.78	2.71	9.42	1.67
CLEAN UP DELAY	36.	6.8	17.55	0.52	0.23	1.18	0.07
VENTILATION	2.	0.4	1.50	0.75	0.28	1.03	0.47
TIMMERING	9.	1.8	54.17	6.02	8.55	29.80	1.25
GAS CHECK	1.	0.2	1.08	1.08	0.0	1.08	1.08
LUNCH	3.	0.6	102.20	34.07	3.14	37.85	30.17
TAKING BOTTOM/STOP	1.	0.2	1.88	1.88	0.0	1.88	1.88
SAFETY - OTHER	1.	0.2	9.43	9.43	0.0	9.43	9.43
SYSTEM - OTHER	4.	0.8	63.90	15.97	14.22	37.02	1.72
OPERATOR DELAY	23.	4.6	4.80	0.21	0.20	0.87	0.07
CONDITIONS - OTHER	1.	0.2	3.32	1.11	0.31	1.48	0.32
SHUTTLE CAR DELAY	12.	2.4	8.20	0.68	0.85	3.27	0.08
LOADING OUT OF PLACE	1.	0.2	37.30	12.43	4.51	18.35	7.42

9950-601

## OVERALL SUMMARY 6 DAYS

## ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
MAN TRIP IN	6.	1.0	179.54	29.92	5.59	38.62	24.12
FACE TRIP IN	6.	1.0	49.95	8.32	4.70	17.62	3.27
MACHINE PREP/MAINTENANCE	6.	1.0	115.70	19.28	6.50	30.98	9.70
POSITIONING FOR NEW CUT	1.	0.2	0.20	0.20	0.0	0.20	0.20
CUTTING	99.	16.5	158.14	1.60	1.96	13.25	0.18
LOADING STANDARD SHUTTLE CAR	98.	16.3	224.05	2.29	1.23	9.20	0.55
LOADING OFF-STANDARD SHUTTLE CAR	99.	16.5	191.47	1.93	0.80	6.25	0.90
LOADING AND/OR CUTTING	205.	34.2	454.31	2.22	1.82	16.98	0.18
WAITING FOR SHUTTLE CAR	198.	33.0	512.72	2.59	3.28	28.68	0.06
PREPARATION FOR PLACE CHANGE	16.	2.7	33.91	2.12	2.99	11.15	0.05
FORWARD TRAM	14.	2.3	42.21	3.01	1.92	6.22	0.53
REVERSE TRAM	12.	2.0	29.55	2.46	1.48	5.28	0.93
MANEUVERING FOR TURN	12.	2.0	21.57	1.80	1.26	4.15	0.12
MANEUVERING TO NEXT CUT/FACE	1.	0.2	14.65	14.65	0.0	14.65	14.65
PREPARATION FOR DEPARTURE	4.	0.7	15.50	3.87	2.95	8.00	0.55
FACE TRIP OUT	6.	1.0	14.55	2.42	1.21	4.35	1.33
WAITING FOR MAN TRIP OUT	6.	1.0	32.36	5.39	2.87	10.33	0.67
MAN TRIP OUT	6.	1.0	171.20	28.53	3.81	34.82	24.03
FORWARD TRAM - END	18.	3.0	52.13	2.90	3.22	10.40	0.07
REVERSE TRAM - BEGIN	12.	2.0	22.99	1.92	1.83	6.10	0.30

## DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CABLE HANDLING DELAY	14.	2.3	9.87	0.70	0.80	3.22	0.10
INSPECTION AND PREPARATION	1.	0.2	3.57	3.57	0.0	3.57	3.57
SECTION POWER	1.	0.2	12.77	12.77	0.0	12.77	12.77
MAINTENANCE DELAY - SCHEDULED	1.	0.2	96.88	96.88	0.0	96.88	96.88
MAINTENANCE DELAY - UNSCHEDULED	5.	0.8	138.51	27.70	31.98	104.90	0.27
LOADING DELAY - MANEUVERING	38.	5.0	21.51	0.72	0.62	3.63	0.03
BIT CHANGE	2.	0.3	6.41	3.20	1.4.	4.68	1.73
PLACE DELAY - BOLTER	1.	0.2	43.72	43.72	0.0	43.72	43.72
TRAFFIC DELAY - BOLTER	5.	0.8	12.86	2.57	1.74	5.87	0.97
CLEAN UP DELAY	11.	1.8	7.04	0.64	0.20	1.03	0.32
VENTILATION	5.	0.8	45.74	9.15	9.77	27.02	0.92
TIMING	10.	1.7	29.32	2.93	1.28	5.13	1.20
ROCK DUSTING	1.	0.2	3.12	3.12	0.0	3.12	3.12
LUNCH	4.	0.7	139.88	34.97	2.25	38.82	33.15
TAKING BOTTOM/TOP	1.	0.2	12.02	12.02	0.0	12.02	12.02
SAFETY - OTHER	1.	0.2	39.17	39.17	0.0	39.17	39.17
SYSTEM - OTHER	10.	1.7	232.98	23.30	16.75	47.73	0.63
OPERATOR DELAY	14.	2.3	2.51	0.18	0.12	0.41	0.08
CONDITIONS - OTHER	1.	0.2	12.27	12.27	0.0	12.27	12.27
CABLE REPAIR	1.	0.2	5.92	5.92	0.0	5.92	5.92
SHUTTLE CAR DELAY	31.	5.2	53.76	1.73	7.56	42.87	0.07
LOADING OUT OF PLACE	1.	0.2	33.67	33.67	0.0	33.67	33.67

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OVERALL SUMMARY OR 6 DAYS

ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
MAN TRIP IN	6.	1.0	202.32	33.72	3.52	39.00	27.98
FACE TRIP IN	6.	1.0	61.20	10.20	4.01	19.00	7.07
MAC...VE PREP/MAINTENANCE	6.	1.0	232.85	38.81	26.53	78.10	12.97
POSITIONING FOR NEW CUT	2.	0.3	0.35	0.17	0.14	0.32	0.03
CUTTING	38.	6.3	42.17	1.11	0.73	3.46	0.10
LOADING STANDARD SHUTTLE CAR	90.	15.0	176.50	1.96	0.75	4.68	0.70
LOADING OFF-STANDARD SHUTTLE CAR	100.	16.7	208.06	2.08	0.79	5.39	0.59
LOADING AND/OR CUTTING	198.	31.7	398.99	2.06	0.80	5.39	0.59
WAITING FOR SHUTTLE CAR	181.	30.2	499.09	2.76	2.95	25.99	0.10
PREPARATION FOR PLACE CHANGE	19.	3.2	29.45	1.55	3.30	15.28	0.08
FORWARD TRAM	11.	1.8	9.30	0.85	0.37	1.33	0.17
REVERSE TRAM	11.	1.8	11.23	1.02	0.45	2.12	0.25
MANEUVERING FOR TURN	12.	2.0	14.13	1.18	1.46	5.92	0.18
MANEUVERING TO NEXT CUT/FACE	6.	1.0	15.63	2.60	2.65	6.78	0.18
PREPARATION FOR DEPARTURE	3.	0.5	6.68	2.23	3.76	3.08	1.23
FACE TRIP OUT	6.	1.0	31.03	5.17	5.04	14.45	0.15
WAITING FOR MAN T P OUT	6.	1.0	38.05	6.34	4.09	12.85	1.55
MAN TRIP OUT	6.	1.0	175.93	29.32	3.05	33.05	23.78
FORWARD TRAM - END	16.	2.7	16.59	1.04	1.10	4.45	0.18
REVERSE TRAM - BEGIN	12.	2.0	18.72	1.56	1.28	5.60	0.63

DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	LOW (MIN)
CABLE HANDLING DELAY	32.	5.3	38.51	1.20	1.30	6.30	0.08
CURTAIN HANDLING DELAY	5.	0.8	6.22	1.24	0.61	2.32	0.70
INSPECTION AND PREPARATION	4.	0.7	8.27	2.07	0.36	2.60	1.57
SECTION POWER	1.	0.2	10.13	0.13	0.0	10.13	10.13
SECTION WATER	1.	0.2	1.77	1.77	0.0	1.77	1.77
MAINTENANCE DELAYS - THE M.L.O.	10.	1.7	50.90	5.09	9.69	24.75	0.07
LOADING DELAY - 1.77 RING	25.	4.2	17.89	0.72	0.44	1.97	0.10
RIT CHANGE	1.	0.2	2.38	2.38	0.0	2.38	2.38
PLACE DELAY - ROCTER	3.	0.5	120.42	40.14	15.27	60.95	24.75
TRAFFIC DELAY - BOLTER	4.	0.7	6.05	1.51	1.35	3.83	0.57
CLEAN UP DELAY	32.	5.3	34.42	1.08	1.44	6.80	0.18
VENTILATION	1.	0.2	2.58	2.58	0.0	2.58	2.58
LUNCH	15.	2.5	113.12	7.54	0.39	35.65	0.82
YARKING BOTTOM/TOP	4.	0.7	141.53	35.38	9.33	46.90	21.08
SAFETY - OTHER	2.	0.3	18.77	4.69	4.07	11.08	1.50
SYSTEM - OTHER	12.	2.0	29.12	14.56	13.91	28.47	0.65
OPERATION DELAY	35.	5.8	76.55	6.38	9.01	32.63	0.27
CONDITIONS - OTHER	2.	0.3	10.33	0.30	0.47	2.23	0.07
CABLE REPAIR	1.	0.2	95.57	47.79	35.03	82.32	12.75
SHUTTLE CAR DELAY	10.	1.7	24.18	24.18	0.0	24.18	24.18
LOADING OUT OF PLACE	2.	0.3	9.34	0.93	1.02	2.97	0.10
			7.29	3.64	1.52	5.17	2.12

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# OVERALL SUMMARY FOR 5 DAYS

## ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN) LOW (MIN)
MAN TRIP IN	5.	1.0	105.00	37.02	1.23	38.50 34.90
FACE TRIP IN	5.	1.0	25.85	5.17	2.15	8.00 2.00
MACHINE PREP/MAINTENANCE	5.	1.0	119.29	23.86	12.89	46.92 8.58
POSITIONING FOR NEW CUT	3.	0.6	8.14	2.71	0.77	3.28 1.63
CUTTING	79.	15.8	97.45	1.23	1.29	7.82 0.10
LOADING STANDARD SHUTTLE CAR	103.	20.6	211.50	2.05	0.77	5.40 0.40
LOADING OFF-STANDARD SHUTTLE CAR	77.	15.4	147.41	1.91	0.74	4.77 0.57
LOADING AND/OR CUTTING	182.	36.4	373.72	2.05	0.95	7.82 0.34
WAITING FOR SHUTTLE CAR	172.	34.4	445.10	2.59	1.85	12.54 0.05
PREPARATION FOR PLACE CHANGE	14.	2.8	21.40	1.53	2.92	11.80 0.08
FORWARD TRAM	9.	1.8	12.11	1.35	0.92	3.62 0.30
REVERSE TRAM	11.	2.2	13.75	1.25	0.90	3.93 0.43
MANEUVERING FOR TURN	12.	2.4	17.51	1.46	0.91	3.92 0.17
PREPARATION FOR DEPARTURE	3.	0.6	5.85	1.95	0.53	2.38 1.28
FACE TRIP OUT	4.	0.8	15.74	3.93	2.84	8.00 0.52
WAITING FOR MAN TRIP OUT	4.	0.8	11.60	2.92	1.01	4.28 1.82
MAN TRIP OUT	5.	1.0	182.64	36.53	2.06	39.35 33.57
FORWARD TRAM - END	17.	3.4	83.50	4.92	10.87	45.50 0.07
REVERSE TRAM - BEGIN	13.	2.6	10.14	0.70	0.65	2.70 0.05

## DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN) LOW (MIN)
CABLE HANDLING DELAY	22.	4.4	13.13	0.60	0.47	1.83 0.00
IN-SECTION AND PREPARATION	4.	0.8	6.70	1.67	1.24	3.67 0.40
SECTION POWER	1.	0.2	2.43	2.43	0.0	2.43 2.43
MAINTENANCE DELAY - SCHEDULED	3.	0.6	4.50	1.50	1.27	3.30 0.55
MAINTENANCE DELAY - UNSCHEDULED	7.	1.4	42.73	6.10	13.25	38.50 0.10
LOADING DELAY - MANEUVERING	19.	3.8	16.46	0.87	0.90	3.92 0.27
PLACE DELAY - BOLTER	3.	0.6	77.13	25.71	16.05	39.33 3.18
TRAFFIC DELAY - BOLTER	7.	1.4	11.34	1.62	0.79	3.15 0.75
CLEAN UP DELAY	31.	6.2	21.70	0.70	0.22	1.41 0.43
VENTILATION	1.	0.2	9.91	3.71	3.73	4.50 0.53
TIMBERING	8.	1.6	22.02	2.75	1.37	4.60 0.37
ROCK DUSTING	1.	0.2	2.87	2.87	0.0	2.87 2.87
GAS CHECK	2.	0.4	2.55	1.27	0.71	1.58 0.97
LUNCH	4.	0.8	161.74	40.43	6.05	50.37 34.92
TAKING BOTTOM/TOP	1.	0.2	0.50	0.50	0.0	0.50 0.50
SAFETY - OTHER	2.	0.4	19.32	9.66	6.31	15.97 3.35
SYSTEM - OTHER	16.	3.2	298.91	18.68	28.55	90.42 0.15
OPERATOR DELAY	20.	4.0	4.79	0.24	0.30	1.22 0.05
CONDITIONS - OTHER	2.	0.4	5.13	2.56	0.94	3.50 1.63
SHUTTLE CAR DELAY	10.	2.0	1.90	0.20	0.04	0.31 0.12

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OVERALL SUMMARY FOR 6 DAYS

ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	RANGE LOW (MIN)
MAN TRIP IN	6.	1.0	160.64	26.77	2.31	29.85	23.03
FACE TRIP IN	6.	1.0	40.76	6.79	1.90	13.55	2.02
MACHINE PREP/MAINTENANCE	6.	1.0	312.42	52.07	45.77	148.92	12.95
POSITIONING FOR NEW CUT	1.	0.2	3.32	3.32	0.0	3.32	3.32
CUTTING	130.	23.0	246.53	1.79	2.95	23.19	0.05
LOADING STANDARD SHUTTLE CAR	106.	17.7	141.30	1.33	1.33	7.51	0.23
LOADING OFF-STANDARD SHUTTLE CAR	90.	16.0	132.42	1.39	0.72	5.12	0.59
LOADING AND/OR CUTTING	222.	37.0	395.86	1.78	2.41	23.87	0.10
WAITING FOR SHUTTLE CAR	218.	36.3	492.03	2.26	2.66	26.50	0.03
PREPARATION FOR PLACE CHANGE	21.	3.5	100.33	4.78	10.08	40.37	0.14
FORWARD TRAM	15.	2.5	42.72	2.85	2.20	8.47	0.75
REVERSE TRAM	15.	2.5	48.93	3.26	2.54	8.54	0.31
MANEUVERING FOR TURN	15.	2.5	14.82	0.99	0.80	3.12	0.12
MANEUVERING TO NEXT CUT/FACE	1.	0.2	35.18	35.18	0.0	35.18	35.18
PREPARATION FOR DEPARTURE	6.	1.0	6.39	1.06	0.56	2.08	0.72
FACE TRIP OUT	6.	1.0	29.77	4.96	2.48	7.63	0.52
WAITING FOR MAN TRIP OUT	6.	1.0	18.83	3.14	1.44	5.50	1.48
MAN TRIP OUT	6.	1.0	164.88	27.48	5.20	36.00	20.53
FORWARD TRAM - END	21.	3.5	68.82	3.24	4.24	17.22	0.02
REVERSE TRAM - BEGIN	15.	2.5	23.47	1.56	2.15	7.47	0.07

DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	RANGE LOW (MIN)
CABLE HANDLING DELAY	27.	4.5	22.85	0.85	1.07	5.72	0.07
CURTAIN HANDLING DELAY	1.	0.2	2.57	2.57	0.0	2.57	2.57
INSPECTION AND PREPARATION	3.	0.5	15.14	5.05	1.88	9.08	0.18
SECTION POWER	6.	1.0	24.95	4.16	0.13	10.13	0.40
MAINTENANCE DELAY - SCHEDULED	2.	0.3	109.75	54.87	51.15	106.03	3.72
MAINTENANCE DELAY - UNSCHEDULED	5.	0.8	75.54	15.11	22.75	59.83	0.25
LOADING DELAY - MANEUVERING	9.	1.5	8.80	0.98	0.59	1.93	0.08
LOADING DELAY - SCALING	1.	0.2	1.45	1.45	0.0	1.45	1.45
PLACE DELAY - BOLTER	3.	0.5	144.15	54.72	16.18	71.45	32.83
TRAFFIC DELAY - ROLTER	3.	0.5	4.34	1.46	1.02	2.88	0.50
CLEAN UP DELAY	9.	1.5	6.36	0.71	0.15	0.95	0.42
VENTILATION	5.	0.8	58.63	11.73	15.02	40.62	0.98
TIMBERING	10.	1.7	28.25	2.82	1.97	6.32	0.10
LUNCH	2.	0.3	67.13	33.57	1.81	37.38	29.75
TAKING BOTTOM/TOP	3.	0.5	18.11	6.11	7.64	16.92	0.54
SAFETY - OTHER	2.	0.3	4.60	2.30	1.44	3.74	0.82
SYSTEM - OTHER	4.	0.7	52.46	13.11	10.52	24.38	0.78
OPERATOR DELAY	15.	2.5	6.51	0.43	0.99	4.12	0.07
CONDITIONS - OTHER	2.	0.3	14.22	7.11	2.89	10.00	4.22
SHUTTLE CAR DELAY	30.	5.0	152.20	5.07	22.38	124.90	0.08
LOADING OUT OF PLACE	1.	0.5	26.90	26.90	9.34	22.25	2.12

# OVERALL SUMMARY FOR 6 DAYS

## ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	RANGE LOW (MIN)
MAN TRIP IN	6.	1.0	222.95	37.16	2.04	40.50	34.83
FACE TRIP IN	6.	1.0	40.00	6.67	3.63	13.58	1.43
MACHINE PREP/MAINTENANCE	6.	1.0	139.76	23.29	19.28	65.15	8.40
CUTTING	72.	12.0	111.31	1.55	1.07	5.92	0.16
LOADING STANDARD SHUTTLE CAR	132.	22.0	195.72	1.48	0.53	3.11	0.50
LOADING OFF-STANDARD SHUTTLE CAR	117.	19.5	173.99	1.49	0.70	4.58	0.15
LOADING AND/OR CUTTING	252.	42.0	401.23	1.59	0.83	5.97	0.16
WAITING FOR SHUTTLE CAR	241.	40.2	802.97	3.33	4.08	31.80	0.03
PREPARATION FOR PLACE CHANGE	21.	3.5	36.21	1.72	2.11	7.85	0.03
FORWARD TRAM	6.	1.0	10.06	1.68	0.94	3.40	0.53
REVERSE TRAM	8.	1.3	31.28	3.91	2.65	9.63	1.43
MANEUVERING FOR TURN	9.	1.5	13.65	1.52	1.21	3.82	0.20
MANEUVERING TO NEXT CUT/FACE	10.	1.7	25.65	2.56	1.52	5.90	0.55
PREPARATION FOR DEPARTURE	5.	0.8	12.57	2.51	1.34	5.47	0.07
FACE TRIP OUT	6.	1.0	41.16	6.86	3.7	13.08	1.98
WAITING FOR MAN TRIP OUT	5.	0.8	38.38	7.68	5.24	17.15	2.48
MAN TRIP OUT	6.	1.0	193.95	32.32	2.34	35.55	29.08
FORWARD TRAM - END	15.	2.5	48.81	3.25	3.73	14.77	0.15
REVERSE TRAM - BEGIN	9.	1.5	19.76	2.20	2.40	6.57	0.18

## DELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN)	RANGE LOW (MIN)
CABLE HANDLING DELAY	10.	1.7	7.52	0.75	0.72	2.78	0.15
MAINTENANCE DELAY - UNSCHEDULED	24.	4.0	93.46	3.89	11.03	54.88	0.13
LOADING DELAY - MANEUVERING	14.	2.3	19.96	1.43	2.91	11.82	0.10
PLACE DELAY - BOLTER	1.	0.2	23.22	23.22	0.0	23.22	23.22
TRAFFIC DELAY - BOLTER	4.	0.7	40.78	10.19	14.01	34.37	0.45
CLEAN UP DELAY	14.	2.3	33.45	2.39	6.38	25.38	0.15
VENTILATION	5.	0.8	46.64	9.33	12.89	34.87	0.33
TIMBERING	18.	3.0	108.28	6.02	4.25	17.52	0.92
GAS CHECK	4.	0.7	5.67	1.42	0.21	1.63	1.15
LUNCH	3.	0.5	94.03	31.34	0.47	31.98	30.87
MACHINE - OTHER	1.	0.2	1.25	1.25	0.0	1.25	1.25
SYSTEM - OTHER	8.	1.3	96.49	12.06	11.04	31.80	0.95
OPERATOR DELAY	15.	2.5	4.95	0.33	0.43	1.75	0.05
CONDITIONS - OTHER	1.	0.2	3.88	3.88	0.0	3.88	3.88
SHUTTLE CAR DELAY	18.	3.0	21.84	1.21	2.43	9.27	0.05
LOADING OUT OF PLACE	1.	0.2	2.97	2.97	0.0	2.97	2.97

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OVERALL SUMMARY FOR 2 DAYS

ACTIVITIES-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN) LOW (MIN)
MAN TRIP IN	2.	1.0	49.65	24.82	0.04	24.87 24.78
FACE TRIP IN	2.	1.0	15.97	7.98	0.07	8.05 7.92
MACHINE PREP/MAINTENANCE	2.	1.0	76.17	38.08	6.17	44.25 31.92
LOADING STANDARD SHUTTLE CAR	34.	17.0	53.92	1.59	0.82	4.22 0.63
LOADING OFF-STANDARD SHUTTLE CAR	23.	11.5	36.12	1.57	0.78	4.04 0.77
LOADING AND/OR CUTTING	57.	28.5	90.04	1.58	0.80	4.22 0.63
WAITING FOR SHUTTLE CAR	57.	28.5	221.29	3.88	2.07	11.48 1.13
PREPARATION FOR PLACE CHANGE	4.	2.0	2.94	0.73	0.66	1.87 0.27
FORWARD TRAM	1.	0.5	4.32	4.32	0.0	4.32 4.32
REVERSE TRAM	3.	1.5	9.57	3.19	1.78	5.67 1.55
MANEUVERING FOR TURN	4.	2.0	33.13	8.28	4.51	15.37 3.90
PREPARATION FOR DEPARTURE	2.	1.0	9.47	4.73	2.62	7.35 2.12
FACE TRIP OUT	2.	1.0	2.02	1.01	0.06	1.07 0.95
WAITING FOR MAN TRIP OUT	2.	1.0	39.97	19.99	6.37	26.35 13.62
MAN TRIP OUT	2.	1.0	48.84	24.42	2.40	26.82 22.02
FORWARD TRAM - END	5.	2.5	38.36	7.67	6.49	16.13 0.07
REVERSE TRAM - BEGIN	3.	1.5	8.11	2.70	1.65	3.98 0.38

RELAYS-CONT. MINER

	FREQ.	AVG. DAILY FREQ.	TOTAL TIME (MIN)	MEAN (MIN)	STANDARD DEVIATION (MIN)	RANGE HIGH (MIN) LOW (MIN)
MAINTENANCE DELAY - UNSCHEDULED	1.	0.5	154.38	154.38	0.0	154.38 154.38
LOADING DELAY - MANEUVERING	11.	5.5	15.47	1.41	0.94	3.93 0.20
CLEAN UP DELAY	6.	3.0	14.77	2.46	1.96	6.20 0.17
VENTILATION	3.	1.5	7.27	2.42	0.60	3.27 1.95
LUNCH	1.	0.5	37.12	37.12	0.0	37.12 37.12
MACHINE - OTHER	1.	0.5	3.13	3.13	0.0	3.13 3.13
SYSTEM - OTHER	1.	0.5	17.52	17.52	0.0	17.52 17.52
OPERATOR DELAY	14.	7.0	3.08	0.22	0.19	0.83 0.08
SHUTTLE CAR DELAY	19.	9.5	2.00	0.11	0.05	0.23 0.03
LOADING OUT OF PLACE	2.	1.0	26.47	13.24	3.78	17.02 9.45

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Industrial Engineering Study of Conventional Mining Equipment

Roof Bolter Source Data

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## 1. GROUND SUPPORT ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MAINTENANCE - IN	1.	10.00	10.00	0.0	10.00	10.00
FACTORY - IN	1.	4.02	4.02	0.0	4.02	4.02
MARK GOLF	1.	1.32	1.32	0.23	1.65	1.12
POSITIONING	42.	17.33	0.41	0.21	1.07	0.15
WILL STARTER	42.	44.51	1.05	0.16	1.46	0.74
CHANGE STEEL	42.	4.11	0.11	0.02	0.17	0.05
WILL NOT	42.	50.35	1.34	0.22	1.95	0.92
INVEST AND FINISH GOLF	42.	20.70	0.50	0.20	1.10	0.27
FACE TEAM	2.	1.94	0.97	0.10	1.07	0.87
PREPARE FOR PLACE CHANGE	6.	1.00	0.40	0.18	0.60	0.18
FORWARD TEAM	5.	2.04	0.47	0.11	0.70	0.43
MAINTENANCE FOR TIME	4.	1.11	0.29	0.06	0.40	0.23
PREPARE FOR OPERATIVE	1.	0.47	0.47	0.0	0.47	0.47
FACTORY - IN	1.	20.27	20.27	0.0	20.27	20.27
MAINTENANCE - IN	1.	29.33	29.33	0.0	29.33	29.33

## 2. GOLF HOLE DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE HANDLING	1.	0.62	0.62	0.0	0.62	0.62
INSPECTION AND PREP. OF HOLE	5.	9.44	1.89	1.46	3.72	0.30
SUPPLY DELAY	1.	0.32	0.32	0.0	0.32	0.32
SAFETY JACK/TIME	2.	22.20	11.10	9.44	20.58	1.62
PLACE DELAY - LOADER	5.	1.65	1.53	1.25	3.62	0.48
FRAMING DELAY - 45C.	2.	51.75	25.87	10.53	36.40	15.35
LUNCH	1.	77.15	77.15	0.0	77.15	77.15
LOOSE HOLE	1.	39.98	39.98	0.0	39.98	39.98
OPERATION DELAY	2.	1.69	0.84	0.18	1.02	0.67
	1.	4.15	4.15	0.0	4.15	4.15

## 3. PLACE CHANGE (TEAM)

TEAM TIME MEASUREMENTS FOR COMPUTATIONS

4.44	55.77	613.24	10	13	23	31	43	40
1.44	400.77	402.75	40	43	43	40		
1.43	415.45	410.12	40	43	43	40		
2.40	409.69	412.55	20	23	13	10		

## 4. TOTAL GOLF HOLE DELAYS = 42 HOURS

OPERATION TIME	100.12	414
NON-MAINTENANCE DELAYS - 45C.	21.72	414
NON-MAINTENANCE DELAYS - 45C.	17.45	414
PREVENTIVE MAINTENANCE DELAYS	0.0	414
CORRECTIVE MAINTENANCE DELAYS	0.0	414
LOOSE	39.98	414
TOTAL FACT TIME	140.99	414

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## 1. WORK MOUNTING ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MANTHIP -IN	1.	49.40	49.40	0.0	49.40	49.40
FACETRIP -IN	1.	13.25	13.25	0.0	13.25	13.25
MACHINE PREP/MAINT	1.	7.33	7.33	0.0	7.33	7.33
MARK WORK	3.	5.72	1.91	0.50	2.58	1.37
POSITION DRILL	42.	27.30	0.65	0.30	1.98	0.37
DRILL STAPLER MILE	40.	30.94	0.77	0.11	1.17	0.65
CHANGE STEEL	41.	4.10	0.10	0.00	0.10	0.10
DRILL MILE	39.	65.16	1.07	0.31	2.34	1.23
INSERT AND TIGHTEN ROOF BOLT	40.	19.48	0.50	0.14	0.92	0.28
FACE TRAM	2.	3.30	1.65	0.13	1.78	1.52
PREPARE FOR PLACE CHANGE	4.	2.11	0.53	0.15	1.05	0.07
FORWARD TRAM	7.	4.05	0.58	0.37	1.40	0.25
MANUEVER FOR TURN	2.	0.65	0.32	0.13	0.45	0.20
PREPARE FOR DEPARTURE	1.	0.54	0.54	0.0	0.54	0.54
FACETRIP -OUT	1.	14.17	14.17	0.0	14.17	14.17
MANTHIP -OUT	1.	44.28	44.28	0.0	44.28	44.28

## 2. WORK MOUNTING DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE HANDLING	2.	4.35	2.17	0.40	2.57	1.78
INSPECTION AND PREP. OF ROOM	1.	0.42	0.42	0.0	0.42	0.42
PLACE DELAY -LOADER	2.	16.30	8.15	27.18	65.33	10.97
CLEAN MIST COLLECTOR	3.	5.33	1.78	0.47	2.40	1.28
TRAMMING DELAY -MSC.	2.	5.50	2.75	2.03	4.78	0.72
GAS CHECK	1.	0.83	0.83	0.0	0.83	0.83
LUNCH	1.	43.20	43.20	0.0	43.20	43.20
OTHER DELAY -SYSTEM	1.	0.73	0.73	0.0	0.73	0.73
OPERATION DELAY	2.	3.31	1.65	1.32	2.98	0.33
ROOF SCALING	1.	0.53	0.53	0.0	0.53	0.53

## 3. PLACE CHANGE (TRAM)

TRAM TIME BEGIN END COORDINATES .....

1.05	574.51	544.97	50	53	43	40
2.24	649.34	554.77	40	43	33	30
2.44	696.32	744.27	30	33	23	20
44.17	740.53	0.0	20	24	23	37

## 4. TOTAL WORK HOURS INCURRED = 40 HOURS

5. OPERATING TIME .....	161.42	410
NON-MAINTENANCE DELAYS-NECESSARY .....	24.91	MIN
NON-MAINTENANCE DELAYS-UNNECESSARY ..	55.44	MIN
UNNECESSARY MAINTENANCE DELAYS .....	0.0	MIN
CONJECTIVE MAINTENANCE DELAYS .....	0.0	MIN
LUNCH .....	43.20	MIN
TOTAL FACE TIME .....	175.85	MIN

## 1. ROOF RELATED ACTIVITIES

FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
1.	10.13	10.13	0.0	10.13	10.13
1.	50.12	50.12	0.0	50.12	50.12
1.	1.38	1.38	0.0	1.38	1.38
1.	10.11	3.37	1.47	5.37	1.87
44.	17.03	0.30	0.13	0.98	0.17
45.	14.44	0.32	0.08	0.52	0.20
46.	7.84	0.17	0.06	0.48	0.07
46.	21.03	0.46	0.07	0.65	0.37
46.	14.38	0.31	0.10	0.58	0.20
4.	4.91	1.23	0.26	1.52	0.87
4.	7.19	0.52	0.17	0.77	0.35
1.	0.08	0.08	0.0	0.08	0.08
1.	35.90	35.90	0.0	35.90	35.90
1.	20.00	20.00	0.0	20.00	20.00

## 2. ROOF HOLETER DELAYS

FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
1.	0.40	0.40	0.0	0.40	0.40
1.	0.42	0.42	0.0	0.42	0.42
1.	40.75	40.75	0.0	40.75	40.75
1.	0.33	0.33	0.0	0.33	0.33
1.	15.67	15.67	0.0	15.67	15.67
1.	0.33	0.33	0.0	0.33	0.33
1.	3.45	3.45	0.0	3.45	3.45
1.	4.63	4.63	0.0	4.63	4.63
1.	39.07	39.07	0.0	39.07	39.07
2.	2.14	1.83	1.83	3.97	0.32
1.	7.23	7.23	0.0	7.23	7.23
4.	102.15	25.54	34.62	85.25	0.52
1.	3.72	3.72	0.0	3.72	3.72

## 3. PLACE CHANGE (TRAM)

TRAM TIME	BEGIN	END	DELAY	COORDINATES
1.12	576.45	577.57	0.00	20 26 16 10
0.37	631.15	631.15	0.00	10 16 26 10
1.47	694.87	694.78	3.44	50 56 46 40
1.18	734.23	734.07	0.41	40 46 36 10

## 4. TOTAL ROOF HOLTS INSERTED = 44 HOLTS

OPERATING TIME	84.67 MIN
NON-MAINTENANCE DELAYS-NECESSARY	23.59 MIN
NON-MAINTENANCE DELAYS-UNNECESSARY	125.90 MIN
PREVENTIVE MAINTENANCE DELAYS	0.0 MIN
CORRECTIVE MAINTENANCE DELAYS	40.75 MIN
LUNCH	39.07 MIN
TOTAL FACE TIME	317.48 MIN

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## 1. HOOF MAINTENANCE ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MANIP - IN	1.	20.70	20.70	0.0	20.70	20.70
FACETIP - IN	1.	39.83	39.83	0.0	39.83	39.83
MANIP HOOF	1.	1.08	1.08	0.0	1.08	1.08
POSITION UNILL	49.	16.54	0.34	0.12	0.73	0.07
DRILL STARTER HOLE	49.	21.20	0.43	0.06	0.67	0.23
CHANGE STEEL	49.	11.99	0.24	0.06	0.60	0.15
UNILL HOLE	48.	23.28	0.48	0.16	1.37	0.33
INSERT AND TIGHTEN HOOF NUT	49.	15.97	0.33	0.06	0.52	0.18
PREPARE FOR PLACE CHANGE	3.	0.98	0.33	0.14	0.47	0.13
FORWARD TRAM	3.	1.16	0.39	0.01	0.40	0.38
MANUEVER FOR TURN	3.	0.21	0.07	0.0	0.07	0.07
PREPARE FOR DEPARTURE	1.	0.42	0.42	0.0	0.42	0.42
FACETIP - OUT	1.	28.08	28.08	0.0	28.08	28.08
MANIP - OUT	1.	19.48	19.48	0.0	19.48	19.48

## 2. HOOF HOLTER DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE HANDLING	2.	2.53	1.26	0.64	1.90	0.63
SAFETY JACK/TIMBERS	2.	2.15	1.07	0.60	1.68	0.47
PLACE DELAY - LOADER	1.	129.40	129.40	0.0	129.40	129.40
CLEAN DUST COLLECTION	1.	0.82	0.82	0.0	0.82	0.82
OPERATION DELAY	3.	1.12	0.37	0.25	0.73	0.17
OTHER DELAY - CONDITIONS	1.	0.22	0.22	0.0	0.22	0.22
CHANGE UNILL BIT	1.	0.28	0.28	0.0	0.28	0.28

## 3. PLACE CHANGE (TRAM)

TRAM TIME BEGIN END COORDINATES .....

0.83 134.23 135.17 50 53 43 40  
 0.87 136.22 136.48 40 43 33 30  
 29.20 135.75 0.0 30 33 23 00

## 4. TOTAL HOOF NUTS INSERTED = 49 NUTS

5. OPERATING TIME ..... 92.78 MIN  
 NON-MAINTENANCE DELAYS-NECESSARY ..... 7.08 MIN  
 NON-MAINTENANCE DELAYS-UNNECESSARY ..... 130.52 MIN  
 PREVENTIVE MAINTENANCE DELAYS ..... 0.0 MIN  
 CORRECTIVE MAINTENANCE DELAYS ..... 0.0 MIN  
 LUNCH ..... 0.0 MIN  
 TOTAL FACE TIME ..... 403.46 MIN



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## 1. ROOF MOUNTER ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MANTRIP - IN	1.	18.33	18.33	0.0	18.33	18.33
FACETRIP - IN	1.	15.25	15.25	0.0	15.25	15.25
MACHINE PREP/MAINT	1.	3.00	3.00	0.0	3.00	3.00
MARK ROOF	4.	9.82	2.45	0.47	2.87	1.67
POSITION DRILL	84.	28.97	0.34	0.13	0.93	0.17
DRILL STARTER HOLE	84.	40.92	0.49	0.10	0.92	0.18
CHANGE STEEL	84.	21.15	0.25	0.05	0.50	0.18
DRILL HOLE	84.	54.19	0.65	0.28	1.72	0.38
INSERT AND TIGHTEN ROOF BOLT	84.	28.52	0.34	0.08	0.63	0.25
PREPARE FOR PLACE CHANGE	5.	2.50	0.50	0.17	0.73	0.25
FORWARD TRAM	4.	1.48	0.37	0.07	0.43	0.25
MANUEVER FOR TRAM	4.	0.43	0.11	0.06	0.17	0.03
REVERSE TRAM	5.	1.59	0.32	0.09	0.42	0.22
PREPARE FOR DEPARTURE	1.	6.50	6.50	0.0	6.50	6.50
FACETRIP - OUT	1.	10.43	10.43	0.0	10.43	10.43
MANTRIP - OUT	1.	17.73	17.73	0.0	17.73	17.73

## 2. ROOF BOLDER DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE HANDLING	5.	2.06	0.41	0.25	0.83	0.15
INSPECTION AND PREP. OF ROOF	2.	0.63	0.31	0.03	0.35	0.28
SUNCTION DELAY	1.	3.05	1.02	0.82	2.15	0.22
SAFETY JACK/TIMBERS	8.	3.14	0.39	0.21	0.67	0.08
PLACE DELAY - LOADER	3.	139.24	46.43	28.54	86.50	22.18
CLEAN DUST COLLECTOR	3.	1.38	0.46	0.09	0.58	0.38
TRAMMING DELAY - MSC.	1.	0.08	0.08	0.0	0.08	0.08
LOOSE BOLT	1.	1.05	1.05	0.0	1.05	1.05
OTHER DELAY - MACHINE	4.	12.28	3.07	4.70	11.20	0.17
OTHER DELAY - SYSTEM	2.	0.54	0.27	0.05	0.32	0.22
OPERATION DELAY	1.	0.55	0.55	0.0	0.55	0.55
CHANGE DRILL BIT	6.	5.15	0.86	0.48	1.53	0.22
ROOF SCALING	3.	9.20	3.07	3.39	7.85	0.42
ROOF/HIB FALL	1.	0.07	0.07	0.0	0.07	0.07

## 3. PLACE CHANGE (TRAM)

TRAM TIME BEGIN END COORDINATES .....

1.84	1891.25	1210.90	10	13	23	37	43	53	50
1.13	1284.93	1246.07	40	43	33	30			
1.14	1323.08	1324.22	30	33	23	20			
1.14	1351.87	1353.02	20	23	13	10			
27.32	1385.35	0.0	10	13	23	37	50	50	50

## 4. TOTAL ROOF BOLTS INSERTED = 84 BOLTS

5. OPERATING TIME ..... 191.27 MIN  
 MIN-MAINTENANCE DELAYS-NECESSARY .... 34.45 MIN  
 MIN-MAINTENANCE DELAYS-UNNECESSARY .. 152.73 MIN  
 MIN-MAINTENANCE DELAYS-UNNECESSARY .. 0.0 MIN

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# 1. WORK REPORTED ACTIVITIES

ACTIVITY	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MAINTENANCE - IN	1.	19.65	19.65	0.0	19.65	19.65
FACTORY - IN	1.	27.88	27.88	0.0	27.88	27.88
INITIAL INSPECTION	1.	1.92	1.92	0.0	1.92	1.92
POSITIONING WHEEL	65.	39.47	0.61	0.41	1.23	0.12
WHEEL STATIONING WHEEL	65.	67.88	1.04	0.27	2.40	0.77
CHARGE STEEL	5.	2.38	0.48	0.13	0.68	0.32
WHEEL WHEEL	5.	4.49	0.98	0.21	1.18	0.58
INSPECT AND TIGHTEN WHEEL NUT	64.	31.36	0.52	0.21	1.65	0.08
FACE TREAD	1.	4.49	1.00	1.96	4.48	0.23
PREPARE FOR PLATE CHANGE	7.	12.52	1.79	0.54	2.77	1.25
PREPARE TREAD	11.	5.94	0.54	0.21	0.72	0.02
MAINTENANCE FOR TREAD	4.	1.99	0.25	0.09	0.44	0.17
REVERSE TREAD	5.	3.79	0.76	0.37	1.20	0.10
FACTORY - INIT	1.	0.62	0.62	0.0	0.62	0.62
MAINTENANCE - OUT	1.	29.73	29.73	0.0	29.73	29.73

# 2. WORK REPORTED DELAYS

ACTIVITY	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CARLE HADN ING	11.	27.12	2.47	4.06	17.87	0.04
INSPECTION AND DEF. OF WORK	1.	5.99	2.00	2.10	4.93	0.13
MECHANICAL DELAY - INSPECTION	1.	0.92	0.92	0.0	0.92	0.92
SUPPLY DELAY	2.	1.53	1.76	1.22	2.98	0.55
SAFETY JACK	22.	64.30	2.92	1.85	8.32	0.73
TOWING TEST	2.	2.29	1.14	0.22	1.37	0.92
TRAINING DELAY - SEC.	4.	3.34	0.38	0.66	2.22	0.02
TRAFFIC DELAY - SECOND	2.	17.71	8.85	0.73	4.58	8.13
GAS CHECK	6.	4.25	0.71	0.42	1.28	0.10
TUNING	1.	44.48	44.48	0.0	44.48	44.48
WORK SCALING	1.	1.72	1.72	0.0	1.72	1.72

# 3. PLATE CHANGE (TRAM)

TRAM TIME	HEIGHT	FREQ.	DELAY	COORDINATES
2.21	575.70	600.07	22.16	51 53 43 46 46
2.46	631.73	635.73	1.64	41 44 43 33 31
1.45	648.23	650.00	0.72	31 24 33 23 21
4.00	715.52	750.65	11.10	21 26 23 33 43
4.40	740.04	801.75	1.07	50 43 53 50
2.00	837.57	854.60	14.79	51 56 53 63 40
3.49	882.07	890.30	1.71	41 46 43 33 30

# 4. TOTAL WORK REPORTED DELAYS

OPERATING TIME	191.67 MIN
NON-MAINTENANCE DELAYS - NECESSARY	107.50 MIN
NON-MAINTENANCE DELAYS - UNNECESSARY	24.62 MIN
DEFECTIVE MAINTENANCE DELAYS	0.0 MIN
DEFECTIVE MAINTENANCE DELAYS	0.32 MIN
TOTAL	323.51 MIN

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## 1. ROOM WORK ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
WAITING - IN	1.	20.15	20.15	0.0	20.15	20.15
FACTORY - IN	1.	8.43	8.43	0.0	8.43	8.43
INITIAL PREPARATION	1.	9.92	9.92	0.0	9.92	9.92
POSITIONING IN	71.	45.60	0.64	1.31	11.28	0.07
DRILL STARTED IN	71.	73.03	1.00	0.24	2.67	0.50
CHANGE STEEL	3.	1.02	0.34	0.13	0.52	0.20
DRILL HOLE	3.	2.87	0.89	0.21	1.13	0.62
INSERT AND TIGHTEN DRILL	71.	26.94	0.34	0.10	0.77	0.25
PREPARE FOR PLATE CHANGE	71.	9.41	1.34	0.58	2.35	0.23
FOURMAN TUN	21.	13.64	0.65	0.19	1.93	0.20
MANUVER FOR TUN	8.	2.57	0.32	0.53	1.65	0.02
DEFENSE TUN	4.	2.66	0.66	0.19	0.93	0.40
PREPARE FOR DEPARTURE	1.	0.57	0.57	0.0	0.57	0.57
FACTORY - IN	1.	17.35	17.35	0.0	17.35	17.35
WAITING - IN	1.	10.00	10.00	0.0	10.00	10.00

## 2. WORK WORKER DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CARL HAN IN	10.	13.72	1.37	1.09	3.53	0.12
INSPECTION AND DEF. OF ROOM	2.	1.43	0.71	0.19	0.90	0.53
SUPPLY DELAY	2.	5.35	2.67	2.23	4.90	0.45
SAFETY JACK	16.	46.19	2.89	3.29	13.27	0.07
PLACE DELAY - LOADED	3.	77.20	25.73	28.04	64.80	0.33
TUNING TEST	1.	0.07	0.07	0.0	0.07	0.07
TRAINING DELAY - HSC.	8.	9.02	1.13	1.69	5.05	0.03
TRAFFIC DELAY - CUTTER	2.	2.71	1.35	0.68	2.03	0.67
TRAFFIC DELAY - LOADED	1.	0.43	0.43	0.0	0.43	0.43
GAS CHECK	1.	2.52	2.52	0.0	2.52	2.52
LUNCH	1.	18.08	18.08	0.0	18.08	18.08
WORK SCALING	1.	1.70	1.70	0.0	1.70	1.70

## 3. PLACE CHANGE (TPM)

TRAM TIME	MEAN	FREQ.	DELAY	COORDINATES
4.00	524.17	533.12	4.04	30 73 43 33 43 53 63 64 60
1.01	544.55	577.00	5.62	40 64 63 53 54 54
2.51	521.75	585.67	61.19	54 54 53 43 44 44
2.51	711.43	781.43	67.49	41 44 43 33 34 34
0.50	829.40	830.70	0.00	31 34 24 24
1.40	836.73	841.00	4.24	20 24 14 14
7.40	845.27	924.24	13.51	11 14 24 34 33 43 53 63 64 64

## 4. TOTAL WORK WORKER DELAYS = 71 WORKS

5. OPERATING TIME ..... 183.62 MIN  
 NON-MAINTENANCE DELAYS-NECESSARY .... 75.54 MIN  
 NON-MAINTENANCE DELAYS-UNNECESSARY .. 44.70 MIN  
 OPERATIVE MAINTENANCE DELAYS ..... 0.0 MIN  
 ..... 0.0 MIN

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## 1. WORK UNITED ACTIVITIES

ACTIVITY	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MAINTENANCE - IN	1.	20.00	20.00	0.0	20.00	20.00
FACTORY - IN	1.	5.50	5.50	0.0	5.50	5.50
POSITION - IN	1.	32.24	32.24	0.31	32.24	32.24
INTEL. STAFFING	57.	56.00	1.00	0.29	2.02	0.28
INTEL. STAFFING	57.	27.36	0.44	0.21	1.37	0.27
FACTORY - IN	1.	0.97	0.97	0.0	0.97	0.97
DEFENSE FOR PLAC CHANGE	4.	4.94	1.23	0.81	2.57	0.42
FORWARD TEAM	11.	6.88	0.63	0.26	1.27	0.15
MAINTENANCE FOR TEAM	3.	0.50	0.17	0.01	0.18	0.15
DEFENSE TEAM	2.	0.45	0.42	0.10	0.52	0.33
DEFENSE FOR DEPARTURE	1.	0.40	0.40	0.0	0.40	0.40
FACTORY - OUT	1.	10.30	10.30	0.0	10.30	10.30
MAINTENANCE - OUT	1.	30.00	30.00	0.0	30.00	30.00

## 2. WORK UNITED DELAYS

ACTIVITY	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE MAINTENANCE	4.	6.50	1.62	1.53	4.02	0.10
SUPPLY DELAY	1.	4.55	4.55	0.0	4.55	4.55
SAFETY DELAY	13.	32.32	2.49	1.97	5.93	0.23
MAINTENANCE DELAY - INTEL	1.	45.97	45.97	0.0	45.97	45.97
MAINTENANCE DELAY	1.	2.27	2.27	0.0	2.27	2.27
TRAINING DELAY - INTEL	2.	11.55	5.77	2.09	7.87	3.68
TRAFFIC DELAY - INTEL	1.	2.15	2.15	0.0	2.15	2.15
TRAFFIC DELAY - SCOP	1.	0.58	0.58	0.0	0.58	0.58
WORKING OUT OF PLAC	1.	16.06	16.06	0.0	16.06	16.06
INTEL	1.	57.70	57.70	0.0	57.70	57.70
OTHER DELAY - MAINTENANCE	2.	0.65	0.32	0.03	0.35	0.30
OTHER DELAY - SYSTEM	2.	3.75	1.88	1.40	3.27	0.48
OPERATION DELAY	2.	6.50	3.25	3.02	6.32	0.27
OTHER DELAY - COMMUNICATIONS	5.	9.68	1.94	2.65	6.98	0.13
CABLE DELAY	1.	36.77	36.77	0.0	36.77	36.77
WORK SCALING	3.	24.03	8.01	6.39	17.03	3.32

## 3. PLAC CHANGE (TEAM)

TEAM TIME NEGATIVE FREQ DELAY COMMUNICATIONS .....

1.20	50.00	57.70	0.21	57	43	44	40
0.17	61.60	61.60	0.00	61	44	34	
5.16	70.23	81.30	40.43	20	24	36	44
2.03	456.00	474.43	17.40	61	64	63	63

## 4. TOTAL WORK UNITS INCURRED = 47 UNITS

1. OPERATING TIME .....	149.61 MIN
NON-MAINTENANCE DELAYS - NECESSARY .....	76.40 MIN
MAINTENANCE DELAYS - NECESSARY .....	75.79 MIN
DEFECTIVE MAINTENANCE DELAYS .....	0.00 MIN
CONSTRUCTIVE MAINTENANCE DELAYS .....	16.77 MIN
INTEL .....	67.70 MIN

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## 1. WORK HOLDING ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MANTHIP - IN	1.	30.00	30.00	0.0	30.00	30.00
FACETWIP - IN	1.	5.77	5.77	0.0	5.77	5.77
MARK WORK	4.	14.52	3.63	0.81	4.75	2.53
POSITION DRILL	70.	43.45	0.62	0.41	2.92	0.17
DRILL STARTUP HOLD	70.	47.14	0.67	0.25	1.60	0.38
CHANGE STEEL	70.	17.00	0.24	0.10	0.73	0.15
DRILL HOLD	70.	31.93	0.46	0.15	0.94	0.20
INSERT AND TIGHTEN HOLD HOLD	71.	37.44	0.53	0.19	1.25	0.27
FACETWIP	1.	0.97	0.97	0.0	0.97	0.97
PREPARE FOR PLACE CHANGE	4.	6.04	1.51	0.72	2.38	0.43
REVERSE THAM	5.	5.55	0.69	0.28	1.18	0.43
MANEUVER FOR TURN	5.	2.43	0.49	0.28	1.03	0.23
REVERSE THAM	3.	2.00	0.67	0.31	1.10	0.40
PREPARE FOR DEPARTURE	1.	1.98	1.98	0.0	1.98	1.98
FACETWIP - INIT	1.	20.13	20.13	0.0	20.13	20.13
MANTHIP - INIT	1.	30.00	30.00	0.0	30.00	30.00

## 2. ROOF HOLDING DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE HANDLING	5.	2.86	0.57	0.44	1.33	0.13
MECHANICAL DELAY - UNSCHEDULED	1.	18.63	18.63	0.0	18.63	18.63
SUCTION DELAY	2.	1.05	0.52	0.15	0.67	0.38
SUPPLY DELAY	1.	4.28	4.28	0.0	4.28	4.28
PLACE DELAY - LOADS	2.	67.72	33.86	22.91	56.77	10.95
CLIPAN DUSE COLLECTION	1.	5.28	5.28	0.0	5.28	5.28
SHOOTING DELAY	1.	0.93	0.93	0.0	0.93	0.93
TRAINING DELAY - MSC.	6.	1.20	0.20	0.16	0.43	0.05
TRAFFIC DELAY - LUNAR	1.	4.55	4.55	0.0	4.55	4.55
LUNCH	1.	32.30	32.30	0.0	32.30	32.30
OTHER DELAY - SAFETY	1.	1.60	1.60	0.0	1.60	1.60
OTHER DELAY - MACHINE	3.	0.77	0.26	0.12	0.43	0.17
OPERATION DELAY	7.	0.32	0.16	0.11	0.27	0.05
OTHER DELAY - CONDITIONS	9.	16.15	1.79	1.27	3.83	0.55
WORK SCALING	5.	3.78	0.76	0.39	1.18	0.13
WORK WITH FALL	2.	2.42	1.41	0.59	2.00	0.82

## 3. PLACE CHANGE (THAM)

THAM TIME MEAN DELAY COORDINATES .....

1.01	550.57	501.20	1.12	34	24	20
0.57	541.57	544.00	0.19	20	24	14
0.94	541.43	545.44	0.77	10	14	24
3.05	547.91	545.00	43.25	20	24	34
3.05	546.40	548.54	0.93	50	54	43

## 4. TOTAL WORK HOLDS INSERTED = 71 HOLDS

5. WORKING TIME ..... 190.50 MIN  
WORK-MANIPULATION ..... 46.94 MIN

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## 1. WORK HOLDING ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MAINTENANCE - IN	1	30.00	30.00	0.0	30.00	30.00
FACETIME - IN	1	10.12	10.12	0.0	10.12	10.12
WORK HOLD	5	16.47	3.29	1.06	5.03	2.28
POSITION IN MILL	45	21.61	0.48	0.27	1.42	0.23
MILL STARTUP INLT	45	28.95	0.64	0.23	1.92	0.37
CHANGE STEEL	45	10.83	0.24	0.11	0.62	0.13
DWILL WIRE	45	17.93	0.40	0.14	0.83	0.17
INSERT AND TIGHTEN HINGE BOLT	45	21.94	0.49	0.16	1.02	0.22
FACE INAM	1	1.60	1.60	0.0	1.60	1.60
PREPARE FOR PLACE CHANGE	3	5.77	1.92	0.80	3.02	1.15
FORWARD TRAN	4	1.67	0.42	0.18	0.62	0.12
MANUEVER FOR TIM	3	1.33	0.44	0.13	0.59	0.27
REVERSE TRAN	1	0.92	0.92	0.0	0.92	0.92
PREPARE FOR DEPARTURE	1	0.38	0.38	0.0	0.38	0.38
FACETIME - INLT	1	4.00	4.00	0.0	4.00	4.00
MAINTENANCE - INLT	1	30.00	30.00	0.0	30.00	30.00

## 2. WORK HOLDING DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CURTAIN HANDLING	1	1.03	1.03	0.0	1.03	1.03
PLACE DELAY - LOADER	2	224.82	112.41	6.46	118.87	105.95
TRAMMING DELAY - MSC	2	0.16	0.08	0.0	0.08	0.00
LUNCH	1	39.80	39.80	0.0	39.80	39.80
OTHER DELAY - MACHINE	2	0.53	0.26	0.17	0.43	0.10
OTHER DELAY - SYSTEM	2	1.79	0.895	0.02	0.87	0.83
OTHER DELAY - CONDITIONS	2	1.33	0.66	0.48	1.15	0.18
CHANGE DWILL HIT	1	1.18	1.18	0.0	1.18	1.18
RUN SCALING	2	0.67	0.33	0.02	0.35	0.32
MUN/WH FALL	2	1.51	0.25	0.07	0.33	0.10

## 3. PLACE CHANGE (TRAN)

TRAN TIME BEGIN END DELAY COORDINATES .....

1.54	025.07	027.05	-0.00	30	34	24	20
1.14	069.40	071.00	0.46	20	24	14	10
2.78	211.10	074.22	144.34	10	14	24	34
1.44	007.24	010.50	1.36	30	34	24	20

## 4. TOTAL MEAN WORKS INSERTED \* 45 WORKS

OPERATING TIME	114.75 MIN
NON-MAINTENANCE DELAYS - NECESSARY	20.16 MIN
NON-MAINTENANCE DELAYS - UNNECESSARY	27.21 MIN
DEFECTIVE MAINTENANCE DELAYS	0.0 MIN
CUMULATIVE MAINTENANCE DELAYS	0.0 MIN
LUNCH	39.80 MIN
TOTAL FACT TIME	304.92 MIN

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## 1. ROOF RULTEM ACTIVITIES

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
MANTRIP -IN	1.	30.00	30.00	0.0	30.00	30.00
FACETRIP -IN	1.	13.25	13.25	0.0	13.25	13.25
INITIAL PREPARATION	1.	21.00	21.00	0.0	21.00	21.00
MARK ROOF	4.	10.33	5.58	0.96	3.62	1.15
POSITION IMILL	40.	23.22	0.58	0.41	2.05	0.07
IMILL STARTER MILE	40.	21.42	0.54	0.09	0.73	0.40
CHANGE STEEL	40.	11.86	0.30	0.08	0.55	0.12
IMILL MILE	40.	26.23	0.66	0.28	1.35	0.23
INSERT AND TIGHTEN ROOF MNT	40.	20.70	0.52	0.21	1.33	0.25
FACE TRAM	1.	1.58	1.58	0.0	1.58	1.58
PREPARE FOR PLACE CHANGE	3.	3.25	1.08	0.26	1.38	0.75
FORWARD TRAM	10.	5.10	0.51	0.17	0.98	0.37
MANUEVER FOR TURN	4.	2.02	0.50	0.37	1.13	0.17
PREPARE FOR DEPARTURE	1.	0.44	0.44	0.0	0.44	0.44
FACETRIP -OUT	1.	19.98	19.98	0.0	19.98	19.98
MANTRIP -UNIT	1.	30.00	30.00	0.0	30.00	30.00

## 2. ROOF MALTER DELAYS

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
CABLE MANULING	4.	2.43	0.61	0.40	1.23	0.20
INSPECTION AND PREP. OF ROOF	2.	2.57	1.28	0.83	2.12	0.45
MECHANICAL DELAY-UNSCHEULD	2.	31.35	15.67	12.79	28.47	2.88
SUPPLY DELAY	1.	12.62	12.62	0.0	12.62	12.62
SAFETY JACK	1.	0.10	0.10	0.0	0.10	0.10
PLACE DELAY -LOADER	4.	122.60	30.65	16.77	44.93	3.93
CLEAN RUST COLLECTION	1.	1.28	1.28	0.0	1.28	1.28
TRAMMING DELAY -MSC.	6.	1.74	0.29	0.27	0.72	0.05
TRAFFIC DELAY -LOADER	1.	3.82	3.82	0.0	3.82	3.82
MOLTING OUT OF PLACE	1.	6.25	6.25	0.0	6.25	6.25
LUNCH	1.	38.17	38.17	0.0	38.17	38.17
OTHER DELAY -SAFETY	4.	2.48	0.62	0.37	1.20	0.23
OTHER DELAY -MACHINE	3.	2.50	0.83	0.50	1.38	0.17
OTHER DELAY -SYSTEM	1.	0.68	0.68	0.0	0.68	0.68
OPERATION DELAY	3.	5.17	1.72	1.51	3.83	0.37
CHANGE IMILL MNT	2.	1.45	0.92	0.30	1.22	0.63

## 3. PLACE CHANGE (TRAM)

TRAM TIME	MBIN	END	DELAY	COORDINATES
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1.14	554.10	593.72	34.44	60	64	54	50
2.43	611.12	646.75	33.00	50	54	44	34
2.30	693.07	783.58	88.21	30	34	24	14
							1L

4. TOTAL ROOF MALTERS INSERTED = 40 MALTERS

5. OPERATING TIME	126.01 MIN
NON-MAINTENANCE DELAYS-NECESSARY	42.04 MIN
NON-MAINTENANCE DELAYS-UNNECESSARY	149.13 MIN

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## 1. ROOF WALKING ACTIVITIES

ACTIVITY	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MANTRIP - IN	1.	18.00	18.00	0.0	18.00	18.00
MARK WALK	7.	15.77	2.25	0.90	3.67	0.63
POSITION IN MILL	70.	56.30	0.80	0.33	2.18	0.25
DRILL STANDER MILE	7.	78.03	1.10	0.38	2.27	0.17
CHANGE STEEL	71.	26.62	0.37	0.15	0.93	0.13
DRILL MILE	71.	32.44	0.46	0.18	0.90	0.22
INSERT AND TIGHTEN ROOF MOLT	71.	32.23	0.45	0.16	1.40	0.28
PREPARE FOR PLACE CHANGE	7.	3.33	0.48	0.51	1.70	0.10
FORWARD TRAM	21.	15.05	0.72	0.21	1.22	0.38
MANUEVER FOR TRAM	5.	0.84	0.17	0.06	0.27	0.08
REVERSE TRAM	1.	1.00	1.00	0.0	1.00	1.00
PREPARE FOR DEPARTURE	1.	0.47	0.47	0.0	0.47	0.47
FACETRIP - INJT	1.	11.47	11.47	0.0	11.47	11.47
MANTRIP - OUT	1.	18.00	18.00	0.0	18.00	18.00

## 2. ROOF WALKING DELAYS

ACTIVITY	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE HANDLING	12.	18.03	1.50	1.57	4.65	0.12
CURTAIN HANDLING	1.	0.13	0.13	0.0	0.13	0.13
INSPECTION AND PREP. OF ROOF	3.	10.39	3.46	2.00	6.10	1.27
SIGNITION DELAY	7.	9.81	1.40	0.94	3.43	0.62
SUPPLY DELAY	1.	11.45	11.45	0.0	11.45	11.45
SAFETY JACK	5.	10.49	2.10	1.22	3.82	0.82
CLEAN DRIST COLLECTOR	5.	8.04	1.61	0.55	2.12	0.62
TRAFFIC DELAY - SHUTTLE CAR	1.	1.00	1.00	0.0	1.00	1.00
HOLDING OUT OF PLACE	1.	4.72	4.72	0.0	4.72	4.72
LUNCH	1.	20.42	20.42	0.0	20.42	20.42
LOOSE MOLT	1.	0.80	0.80	0.0	0.80	0.80
OTHER DELAY - MAC TIME	3.	2.74	0.91	0.32	1.32	0.55
OTHER DELAY - SYSTEM	10.	20.24	2.02	0.54	2.68	0.70
OPERATION INFLAY	6.	2.07	0.34	0.31	0.95	0.10
OTHER DELAY - CONDITIONS	3.	9.69	3.23	4.10	9.03	0.23
CHANGE DRILL MILE	7.	4.22	0.60	0.36	1.37	0.27
MOOF SCALING	3.	2.07	0.69	0.46	1.32	0.22
MOOF/MILE FALL	1.	2.63	2.63	0.0	2.63	2.63

## 3. PLACE CHANGE (TRAM)

TRAM TIME	HEIGH	E-M	DELAY	COORDINATES
3.50	502.67	510.43	4.60	50 53 52 42 43 40
3.47	563.77	574.43	7.49	40 43 42 32 33 30
3.54	614.34	620.44	1.05	30 33 32 22 23 20
2.61	654.12	656.43	0.14	20 23 13 10
5.44	724.40	741.40	11.22	10 13 23 22 32 42 52 62 73 70
2.69	774.74	777.24	4.41	70 73 63 60
1.50	835.97	850.44	10.46	60 63 62 52 53 50

4. TOTAL RISK FOR IS INSTALLED = 71 MILES



## 1. ROOF HOLTEN ACTIVITIES

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
MANTRIP -IN	1.	15.30	15.30	0.0	15.30	15.30
FACETRIP -IN	1.	10.73	10.73	0.0	10.73	10.73
INITIAL PREPARATION	1.	6.47	6.47	0.0	6.47	6.47
MARK HOLE	7.	16.62	2.37	1.92	5.88	0.52
POSITION DRILL	59.	24.77	0.50	0.19	1.42	0.25
DRILL STARTER HOLE	60.	40.17	0.67	0.17	1.31	0.38
CHANGE STEEL	58.	18.46	0.32	0.08	0.65	0.13
DRILL HOLE	58.	19.63	0.34	0.09	0.60	0.15
INSERT AND TIGHTEN ROOF HOLT	60.	19.32	0.32	0.08	0.70	0.20
FACE TRAM	1.	0.53	0.53	0.0	0.53	0.53
PREPARE FOR PLACE CHANGE	5.	1.53	0.31	0.14	0.48	0.17
FORWARD TRAM	16.	13.14	0.82	0.26	1.47	0.42
MAKEOVER FOR TRAM	3.	0.91	0.30	0.05	0.35	0.23
PREPARE FOR DEPARTURE	1.	0.05	0.05	0.0	0.05	0.05
FACETRIP -OUT	1.	13.14	13.10	0.0	13.10	13.10
MANTRIP -OUT	1.	9.73	9.73	0.0	9.73	9.73

## 2. ROOF HOLTEN DELAYS

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
CABLE HANDLING	6.	17.72	2.95	4.02	11.72	0.25
CURTAIN HANDLING	2.	14.74	7.37	4.40	11.77	2.97
INSPECTION AND PREP. OF ROOM	5.	15.93	3.19	2.95	8.73	0.25
MECHANICAL DELAY-RESCHEMLED	1.	18.25	18.25	0.0	18.25	18.25
SUNCTION DELAY	8.	2.06	0.26	0.16	0.67	0.12
SAFETY JACK	4.	9.95	2.49	0.74	3.45	1.67
PLACE DELAY -LUNAR	3.	111.47	37.16	29.52	73.87	1.58
TRAMMING DELAY -MSC.	2.	1.36	0.68	0.50	1.18	0.18
GAS CHECK	1.	0.43	0.21	0.06	0.28	0.15
LUNCH	1.	45.72	45.72	0.0	45.72	45.72
OTHER DELAY -MACHINE	3.	1.44	0.48	0.35	0.93	0.08
OPERATOR DELAY -SYSTEM	1.	6.67	6.67	0.0	6.67	6.67
OPERATOR DELAY	1.	0.72	0.72	0.0	0.72	0.72
CHANGE DRILL HIT	5.	4.42	0.88	0.19	1.13	0.62
ROOF/HOLE FALL	2.	0.95	0.47	0.29	0.77	0.18

## 3. PLACE CHANGE (TRAM)

TRAM TIME	MEGIM	END	DELAY	COORDINATES
2.30	482.08	464.30	0.00	43 33 30
3.01	495.21	498.57	0.33	30 33 23
2.32	547.92	544.04	13.44	20 23 13
7.11	545.97	440.65	47.57	10 13 23
4.62	671.91	724.12	51.51	70 73 12
4.41	771.04	463.58	44.04	64 43 62

4. TOTAL ROOF HOLTS (USED) = 60 HOLTS

5. OPERATING TIME ..... 170.44 MIN

## 1. ROOF BOLTER ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MANTRIP -IN	1.	35.33	35.33	0.0	35.33	35.33
FACETRIP -IN	1.	11.43	11.43	0.0	11.43	11.43
MARK ROOF	1.	1.02	1.02	0.0	1.02	1.02
POSITION MILL	24.	11.27	0.47	0.20	1.15	0.28
DRILL STANCHER WIRE	26.	24.87	0.46	0.19	1.43	0.58
CHANGE STEEL	26.	8.80	0.34	0.06	0.48	0.23
DRILL HOLE	26.	7.03	0.27	0.05	0.42	0.20
INSERT AND TIGHTEN HOOF BOLT	25.	8.31	0.33	0.08	0.47	0.17
FACE TRAM	1.	0.57	0.57	0.0	0.57	0.57
PREPARE FOR PLACE CHANGE	3.	0.77	0.26	0.01	0.27	0.25
FORWARD TRAM	1.	0.42	0.42	0.0	0.42	0.42
MANEUVER FOR TURN	2.	0.10	0.05	0.03	0.08	0.02
REVERSE TRAM	2.	1.02	0.51	0.24	0.75	0.27
PREPARE FOR DEPARTURE	1.	0.33	0.33	0.0	0.33	0.33
FACETRIP -OUT	1.	9.35	9.35	0.0	9.35	9.35
MANTRIP -OUT	1.	26.58	26.58	0.0	26.58	26.58

## 2. ROOF BOLTER DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE HANDLING	5.	12.17	2.43	2.46	7.13	0.42
INSPECTION AND PREP. OF HOOF	2.	6.60	3.30	0.83	4.13	2.47
PLACE DELAY -LOOPER	3.	245.18	81.73	69.54	176.10	10.58
BOLTING OUT OF PLACE	1.	12.03	12.03	0.0	12.03	12.03
LUNCH	1.	29.62	29.62	0.0	29.62	29.62
CHANGE DRILL BIT	1.	0.47	0.47	0.0	0.47	0.47

## 3. PLACE CHANGE (TRAM)

TRAM TIME BEGIN END DELAY COORDINATES .....

1.22	596.58	617.02	15.22	70	71	61	60
1.36	637.00	642.90	200.14	60	61	51	50

## 4. TOTAL ROOF BOLTS INSERTED = 25 BOLTS

5. OPERATING TIME .....	77.46 MIN
NON-MAINTENANCE DELAYS-NECESSARY .....	20.26 MIN
NON-MAINTENANCE DELAYS-UNNECESSARY ..	245.18 MIN
PREVENTIVE MAINTENANCE DELAYS .....	0.0 MIN
CORRECTIVE MAINTENANCE DELAYS .....	0.0 MIN
LUNCH .....	29.62 MIN
TOTAL FACE TIME .....	346.47 MIN

## 1. ROOF WALTER ACTIVITIES

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
MANTRIP -IN	1.	36.43	36.43	0.0	36.43	36.43
FACETRIP -IN	1.	1.23	1.23	0.0	1.23	1.23
MARK ROOF	1.	1.48	1.48	0.0	1.48	1.48
POSITION DRILL	42.	22.31	0.53	0.37	2.23	0.20
DRILL STARTER HOLE	43.	37.37	0.87	0.17	1.57	0.65
CHANGE STEEL	41.	13.58	0.33	0.08	0.78	0.22
DRILL HOLE	41.	7.85	0.19	0.04	0.32	0.12
INSERT AND TIGHTEN ROOF BOLT	41.	13.85	0.34	0.07	0.55	0.20
PREPARE FOR PLACE CHANGE	3.	0.61	0.20	0.09	0.28	0.08
FORWARD TRAM	2.	0.65	0.32	0.17	0.50	0.15
MANEUVER FOR TURN	4.	0.62	0.15	0.14	0.37	0.03
REVERSE TRAM	4.	1.36	0.34	0.22	0.71	0.15
FACETRIP -OUT	1.	10.77	10.77	0.0	10.77	10.77
MANTRIP -OUT	1.	25.70	25.70	0.0	25.70	25.70

## 2. ROOF WALTER DELAYS

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
CABLE HANDLING	1.	0.20	0.20	0.0	0.20	0.20
MECHANICAL DELAY-UNSCHEMLED	1.	22.68	22.68	0.0	22.68	22.68
PLACE DELAY -LOOPER	1.	82.43	82.43	0.0	82.43	82.43
CLEAN DUST COLLECTION	1.	2.97	2.97	0.0	2.97	2.97
ROLLING OUT OF PLACE	1.	64.13	64.13	0.0	64.13	64.13
LUNCH	1.	30.00	30.00	0.0	30.00	30.00
OTHER DELAY -SAFETY	1.	20.77	20.77	0.0	20.77	20.77
OTHER DELAY -SYSTEM	2.	0.58	0.29	0.16	0.45	0.13
OPERATOR DELAY	1.	24.45	24.45	0.0	24.45	24.45
OTHER DELAY -COMMUNICATIONS	2.	0.78	0.39	0.16	0.55	0.23

## 3. PLACE CHANGE (TRAM)

TRAM TIME BEGIN END DELAY COORDINATES .....

0.46	575.80	579.25	2.99	40	46	56	50
1.84	595.67	599.00	0.00	50	56	55	55
0.48	749.90	749.43	0.05	60	66	76	70
0.49	749.42	769.07	0.16	70	76	86	60

## 4. TOTAL WIND BOLTS INSERTED = 41 BOLTS

5. OPERATING TIME .....	163.59 MIN
NON-MAINTENANCE DELAYS-NECESSARY .....	26.20 MIN
NON-MAINTENANCE DELAYS-UNNECESSARY .....	107.46 MIN
PREVENTIVE MAINTENANCE DELAYS .....	0.0 MIN
CORRECTIVE MAINTENANCE DELAYS .....	22.68 MIN
LUNCH .....	30.00 MIN
TOTAL FACE TIME .....	345.94 MIN

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## 1. ROOF HOIST ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MANSHIP - IN	1.	35.33	35.33	0.0	35.33	35.33
MARK ROOF	1.	1.07	1.07	0.0	1.07	1.07
POSITION ON RILL	16.	5.30	0.33	0.20	1.00	0.10
DRILL STARTED - HLT	16.	11.02	0.69	0.24	0.98	0.40
CHANGE STEEL	16.	5.15	0.32	0.06	0.43	0.25
WILL HLT	16.	8.14	0.51	0.19	0.80	0.28
INSERT AND TIGHTEN WINIF HOLT	16.	5.44	0.37	0.07	0.62	0.30
PREPARE FOR PLACE CHANGE	1.	0.22	0.22	0.0	0.22	0.22
FORWARD TEAM	6.	1.40	0.30	0.12	0.53	0.17
MANEUVER FOR TURN	2.	0.72	0.36	0.34	0.70	0.02
FACETHIP - INIT	1.	7.37	7.37	0.0	7.37	7.37
MANSHIP - INIT	1.	25.70	25.70	0.0	25.70	25.70

## 2. ROOF HOIST DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE MANUWING	2.	3.70	1.85	1.72	3.57	0.13
SUCTION DELAY	1.	0.80	0.80	0.0	0.80	0.80
PLACE DELAY - LOADER	1.	41.65	41.65	0.0	41.65	41.65
TRAFFIC DELAY - SHUTTLE CAR	1.	0.32	0.32	0.0	0.32	0.32
LUNCH	1.	26.00	26.00	0.0	26.00	26.00
OTHER DELAY - SYSTEM	3.	152.70	50.90	70.03	149.93	0.87

## 3. PLACE CHANGE (TEAM)

TRAM TIME BEGIN END DELAY COORDINATES .....

0.40 431.52 412.47 0.01 70 76 66 60

## 4. TOTAL ROOF HOLTS INCREASING = 16 HOLTS

5. OPERATING TIME ..... 41.20 MIN  
 NON-MAINTENANCE DELAYS-NECESSARY ..... 4.77 MIN  
 NON-MAINTENANCE DELAYS-UNNECESSARY .. 194.67 MIN  
 PREVENTIVE MAINTENANCE DELAYS ..... 0.0 MIN  
 CORRECTIVE MAINTENANCE DELAYS ..... 0.0 MIN  
 LUNCH ..... 26.00 MIN  
 TOTAL FACT TIME ..... 355.67 MIN

## 1. ROOF WOLTER ACTIVITIES

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
MANTRIP -IN	1.	62.08	62.08	0.0	62.08	62.08
FACETRIP -IN	1.	28.60	28.60	0.0	28.60	28.60
INITIAL PREPARATION	1.	5.62	5.62	0.0	5.62	5.62
MARK ROOF	4.	7.72	1.93	0.35	2.30	1.42
POSITION DRILL	JA.	19.06	0.50	0.25	1.18	0.18
DRILL STAKER HALF	JA.	19.45	0.51	0.11	0.81	0.33
CHANGE STEEL	JA.	10.94	0.29	0.09	0.50	0.15
DRILL HOLE	JA.	24.56	0.65	0.17	1.54	0.45
INSERT AND TIGHTEN PINN HOLT	JA.	39.37	1.04	0.20	1.52	0.60
PREPARE FOR PLACE CHANGE	3.	1.60	0.53	0.21	0.75	0.25
FORWARD TEAM	7.	3.53	0.50	0.13	0.78	0.38
MANEUVER FOR TURN	4.	0.62	0.15	0.09	0.27	0.02
PREPARE FOR DEPARTURE	1.	0.02	0.02	0.0	0.02	0.02
FACETRIP -OUT	1.	7.88	7.88	0.0	7.88	7.88
MANTRIP -OUT	1.	47.83	47.83	0.0	47.83	47.83

## 2. ROOF WOLTER DELAYS

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
CABLE HANDLING	4.	1.05	0.26	0.09	0.42	0.18
SUCTION DELAY	2.	0.23	0.11	0.04	0.15	0.08
SUPPLY DELAY	1.	0.25	0.25	0.0	0.25	0.25
PLACE DELAY -LOADER	4.	98.22	24.55	8.70	39.10	16.12
INSERT WRENCH	36.	3.53	0.10	0.03	0.20	0.07
TRAMMING DELAY -MSC.	1.	0.48	0.48	0.0	0.48	0.48
TRAFFIC DELAY -CUTTER	2.	10.04	5.02	0.35	5.37	4.67
GAS CHECK	2.	4.53	2.26	0.57	2.83	1.70
LUNCH	1.	35.12	35.12	0.0	35.12	35.12
OTHER DELAY -SYSTEM	4.	29.85	7.46	7.38	15.75	0.10
OPERATION DELAY	3.	11.03	3.68	3.80	9.02	0.48
OTHER DELAY -CONDITIONS	1.	0.43	0.43	0.0	0.43	0.43
CHANGE DRILL BIT	1.	1.42	1.42	0.0	1.42	1.42

## 3. PLACE CHANGE (TRAM)

TRAM TIME HGT,IN ENJ DELAY COORDINATES .....

1.13	550.05	551.78	0.60	23	73	43	44	4L
1.38	541.20	513.30	28.72	4L	44	43	33	30
0.43	644.40	709.13	59.90	10	33	23	20	
1.33	750.10	747.17	35.74	20	23	13	10	

## 4. TOTAL WOLF HOLTS INSERTED = 34 HOLTS

5. OPERATING TIME .....	124.76 MIN
NON-MAINTENANCE DELAYS-NECESSARY ....	20.77 MIN
NON-MAINTENANCE DELAYS-UNNECESSARY ..	144.87 MIN
PREVENTIVE MAINTENANCE DELAYS .....	0.0 MIN
CORRECTIVE MAINTENANCE DELAYS .....	0.0 MIN
LUNCH .....	35.12 MIN
TOTAL FACT TIME .....	245.43 MIN

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## 1. WORK CENTER ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MANIP - IN	1.	91.70	91.70	0.0	91.70	91.70
FACE TWP - IN	1.	24.60	24.60	0.0	24.60	24.60
INITIAL PREPARATION	1.	5.62	5.62	0.0	5.62	5.62
HAIR WORK	4.	7.72	1.93	0.35	2.30	1.42
POSITION DRILL	JA.	19.06	0.50	0.25	1.18	0.18
DRILL STARTER WIRE	JA.	19.45	0.51	0.11	0.81	0.33
CHANGE STEEL	JA.	10.94	0.29	0.09	0.50	0.15
DRILL WIRE	JA.	24.56	0.65	0.17	1.54	0.45
INSERT AND TIGHTEN NUT HOLT	JA.	39.37	1.04	0.20	1.52	0.60
PREPARE FIM PLACE CHAIR	3.	1.60	0.53	0.21	0.75	0.25
FORWARD TRAM	7.	3.53	0.50	0.13	0.78	0.38
MANUEVER FOR TURN	4.	0.62	0.15	0.09	0.27	0.02
PREPARE FIM DEPARTURE	1.	0.02	0.02	0.0	0.02	0.02
FACE TWP - OUT	1.	7.88	7.88	0.0	7.88	7.88
MANIP - OUT	1.	47.83	47.83	0.0	47.83	47.83

## 2. WORK CENTER DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE HANDLING	4.	1.05	0.26	0.09	0.42	0.18
SUCTION DELAY	2.	0.23	0.11	0.04	0.15	0.08
SUPPLY DELAY	1.	0.25	0.25	0.0	0.25	0.25
PLACE DELAY - LUBRIC	4.	98.22	24.55	8.70	39.10	16.12
INSERT WRENCH	36.	3.53	0.10	0.03	0.20	0.07
TRAMMING DELAY - MSC.	1.	0.48	0.48	0.0	0.48	0.48
TRAFFIC DELAY - CUTTER	2.	10.04	5.02	0.35	5.37	4.67
GAS CHECK	2.	4.53	2.26	0.57	2.83	1.70
LUNCH	1.	35.12	35.12	0.0	35.12	35.12
OTHER DELAY - SYSTEM	2.	0.23	0.12	0.01	0.13	0.10
INFORMATION DELAY	3.	11.03	3.68	3.80	9.02	0.48
OTHER DELAY - CONDITIONS	1.	0.43	0.43	0.0	0.43	0.43
CHANGE DRILL BIT	1.	1.42	1.42	0.0	1.42	1.42

## 3. PLACE CHANGE (TRAM)

TRAM TIME BEGIN END DELAY COORDINATES .....

1.11	559.85	551.78	0.00	21	33	43	44	4L
1.11	581.20	613.30	24.72	4L	44	43	33	30
0.41	643.60	709.11	59.40	30	33	23	20	
1.11	750.10	747.17	15.74	20	23	13	10	

## 4. TOTAL WORK HOURS INSERTED = 34 HOURS

1.11	559.85	551.78	0.00	21	33	43	44	4L
1.11	581.20	613.30	24.72	4L	44	43	33	30
0.41	643.60	709.11	59.40	30	33	23	20	
1.11	750.10	747.17	15.74	20	23	13	10	

1.11	559.85	551.78	0.00	21	33	43	44	4L
1.11	581.20	613.30	24.72	4L	44	43	33	30
0.41	643.60	709.11	59.40	30	33	23	20	
1.11	750.10	747.17	15.74	20	23	13	10	

## 1. ROOF BOLTER ACTIVITIES

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
MANTRIP -IN	1.	56.17	56.17	0.0	56.17	56.17
FACETRIP -IN	1	13.17	13.17	0.0	13.17	13.17
INITIAL PREPARATION	1.	14.00	14.00	0.0	14.00	14.00
MARK ROOF	5.	12.36	2.47	1.34	4.65	0.78
POSITION DRILL	63.	34.48	0.55	0.30	1.75	0.13
DRILL STARTER HOLE	63.	37.14	0.59	0.21	1.17	0.32
CHANGE STEEL	63.	14.51	0.23	0.11	0.87	0.12
DRILL HOLE	63.	40.26	0.73	0.36	2.38	0.30
INSERT AND TIGHTEN ROOF HOLT	63.	63.82	1.01	0.28	2.12	0.57
PREPARE FOR PLACE CHANGE	6.	3.32	0.55	0.23	0.90	0.27
FORWARD TRAM	13.	7.19	0.55	0.28	1.45	0.32
MANEUVER FOR TRAM	4.	1.08	0.27	0.09	0.38	0.13
PREPARE FOR INPARTIME	1.	3.23	3.23	0.0	3.23	3.23
FACETRIP -OUT	1.	16.17	16.17	0.0	16.17	16.17
MANTRIP -OUT	1.	41.82	41.82	0.0	41.82	41.82

## 2. ROOF BOLTER DELAYS

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
CABLE HANDLING	2.	0.53	0.26	0.02	0.28	0.25
CURTAIN HANDLING	1.	0.20	0.20	0.0	0.20	0.20
INSPECTION AND PREP. OF ROOM	1.	0.82	0.82	0.0	0.82	0.82
SECTION POWER DOWN	1.	2.52	2.52	0.0	2.52	2.52
MECHANICAL DELAY-UNSCHEDULED	3.	12.70	4.23	1.95	6.70	1.93
SUCTION DELAY	10.	11.11	1.11	0.66	2.52	0.12
SUPPLY DELAY	1.	3.13	3.13	0.0	3.13	3.13
SAFETY JACK	1.	0.52	0.52	0.0	0.52	0.52
PLACE DELAY -LOADER	1.	5.32	5.32	0.0	5.32	5.32
INSERT WRENCH	57.	6.11	0.11	0.03	0.22	0.07
CLEAN DUST COLLECTION	1.	1.93	1.93	0.0	1.93	1.93
TRAMMING DELAY -MSC.	3.	1.36	0.45	0.55	1.23	0.03
TRAFFIC DELAY -CUTTER	2.	0.98	0.49	0.41	0.90	0.08
TRAFFIC DELAY -SHUTTLE CAR	1.	0.82	0.82	0.0	0.82	0.82
GAS CHECK	1.	0.78	0.78	0.0	0.78	0.78
OTHER DELAY -SAFETY	4.	1.66	0.41	0.20	0.57	0.08
OTHER DELAY -MACHINE	2.	23.05	11.52	11.01	22.53	0.52
OTHER DELAY -SYSTEM	1.	6.90	6.90	0.0	6.90	6.90
OPERATOR DELAY	5.	6.69	1.34	1.15	3.43	0.27
OTHER DELAY -CONDITIONS	3.	21.13	7.04	7.31	17.37	1.38

## 3. PLACE CHANGE (TRAM)

TRAM TIME	BEGIN	END	DELAY	COORDINATES
1.82	505.70	509.57	2.05	22 23 33 43 44 4L
1.54	552.27	559.50	5.69	4L 44 43 33 30
1.52	600.12	611.80	10.16	30 33 23 20
1.27	659.43	660.15	0.45	20 23 13 10
2.61	690.55	700.37	7.14	10 13 23 33 30
1.43	741.30	747.05	0.32	30 33 43 44 4L

## 4. TOTAL ROOF HOLTS INSERTED = 63 HOLTS

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## 1. ROOF BOLTER ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MANTRIP -IN	1.	59.47	59.47	0.0	59.47	59.47
FACETRIP -IN	1.	16.85	16.85	0.0	16.85	16.85
INITIAL PREPARATION	1.	15.13	15.13	0.0	15.13	15.13
MARK ROOM	1.	1.68	1.68	0.0	1.68	1.68
POSITION INILL	64.	43.48	0.68	0.49	2.98	0.18
DRILL STARTER INLE	64.	38.55	0.60	0.14	1.00	0.40
CHANGE STEEL	64.	16.78	0.26	0.10	0.58	0.08
DRILL HOLE	64.	46.43	0.73	0.24	1.67	0.50
INSERT AND TIGHTEN ROOF BOLT	64.	69.86	1.09	0.22	1.77	0.55
PREPARE FOR PLACE CHANGE	7.	3.38	0.48	0.26	0.92	0.07
FORWARD TEAM	14.	7.62	0.54	0.19	1.01	0.28
MANUEVER FOR TURN	4.	0.80	0.20	0.12	0.35	0.02
PREPARE FOR DEPARTURE	1.	0.41	0.41	0.0	0.41	0.41
FACETRIP -OUT	1.	11.32	11.32	0.0	11.32	11.32
MANTRIP -OUT	1.	47.32	47.32	0.0	47.32	47.32

## 2. ROOF BOLTER DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE HANDLING	9.	12.19	1.35	1.05	3.78	0.15
CURTAIN HANDLING	1.	0.17	0.17	0.0	0.17	0.17
INSPECTION AND PREP. OF ROOM	2.	1.73	0.86	0.71	1.56	0.15
MECHANICAL DELAY-UNSCHEDEUL	3.	10.82	3.61	2.97	7.72	0.82
SUCTION DELAY	4.	1.77	0.44	0.18	0.72	0.28
SUPPLY DELAY	2.	9.77	4.89	0.58	5.47	4.39
PLACE DELAY -LOADER	2.	11.72	5.86	3.99	9.85	1.87
INSERT WRENCH	63.	6.27	0.10	0.03	0.18	0.05
CLEAN DUST COLLECTION	1.	3.55	3.55	0.0	3.55	3.55
TRAPPING DELAY -MSC.	3.	0.29	0.10	0.02	0.12	0.07
TRAFFIC DELAY -SMUTLE CAN	1.	0.87	0.87	0.0	0.87	0.87
ROLLING OUT OF PLACE	1.	18.88	18.88	0.0	18.88	18.88
GAS CHECK	4.	5.25	1.31	0.57	2.12	0.63
LOOSE BOLT	1.	0.33	0.33	0.0	0.33	0.33
OTHER DELAY -SAFETY	1.	2.20	2.20	0.0	2.20	2.20
OTHER DELAY -MACHINE	6.	0.81	0.13	0.05	0.22	0.07
OPERATOR DELAY	3.	1.75	0.58	0.38	0.98	0.07
OTHER DELAY -CONDITIONS	1.	0.32	0.32	0.0	0.32	0.32
CHANGE DRILL HIT	2.	2.62	1.31	0.49	1.80	0.82

## 3. PLACE CHANGE (TEAM)

TEAM TIME BEGIN END DELAY COORDINATES .....

1.71	515.63	523.07	5.73	J1	32	J3	23	20
1.73	559.02	560.58	0.23	20	23	13	10	
1.48	549.93	544.07	2.66	10	13	23	33	30
0.55	656.82	657.17	0.00	30	34	44	40	
2.75	702.14	707.65	2.72	40	44	43	33	23
1.60	734.77	740.73	2.36	20	23	13	10	
2.84	772.50	777.02	2.48	10	13	23	33	30



## 1. ROOF WALTEN ACTIVITIES

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
MANTRIP -IN	1.	54.42	54.42	0.0	54.42	54.42
MARK ROOF	3.	11.77	3.92	0.65	4.72	3.12
POSITION DRILL	44.	43.38	0.99	0.82	3.80	0.38
DRILL STARTER HOLE	44.	56.26	1.17	0.24	1.88	0.37
CHANGE STEEL	8.	3.17	0.40	0.21	0.93	0.18
DRILL HOLE	9.	3.45	0.38	0.33	1.27	0.05
INSERT AND TIGHTEN ROOF BOLT	46.	22.12	0.48	0.17	1.20	0.30
PREPARE FOR PLACE CHANGE	5.	8.48	1.70	3.80	3.00	0.92
FORWARD TEAM	11.	6.48	0.59	0.26	1.32	0.33
MANEUVER FOR TURN	5.	1.33	0.27	0.16	0.48	0.02
PREPARE FOR DEPARTURE	1.	0.25	0.25	0.0	0.25	0.25
FACETHIP -OUT	1.	21.43	21.43	0.0	21.43	21.43
MANTRIP -OUT	1.	42.53	42.53	0.0	42.53	42.53

## 2. ROOF WALTEN DELAYS

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
CURTAIN HANDLING	2.	1.02	0.51	0.09	0.60	0.42
SUCTION DELAY	5.	1.43	0.29	0.05	0.37	0.23
PLACE DELAY -LOADER	5.	122.31	24.46	10.74	35.03	5.13
LUNCH	1.	35.53	35.53	0.0	35.53	35.53
OTHER DELAY -SYSTEM	5.	1.43	0.29	0.15	0.50	0.13

## 3. PLACE CHANGE (TEAM)

TEAM	TIME	BEGIN	END	DELAY	COORDINATES
1.59	524.02	564.35	33.94	30	33 43 40
2.68	597.78	636.42	36.04	40	43 33 23
2.43	664.45	709.70	40.82	21	24 23 13
2.59	735.02	766.17	27.76	10	13 23 33
1.49	802.20	825.75	23.06	30	33 43 40

## 4. TOTAL ROOF BOLTS INSERTED = 46 BOLTS

5. OPERATING TIME	151.59 MIN
NON-MAINTENANCE DELAYS-NECESSARY	11.77 MIN
NON-MAINTENANCE DELAYS-UNNECESSARY	123.74 MIN
PREVENTIVE MAINTENANCE DELAYS	0.0 MIN
CONNECTIVE MAINTENANCE DELAYS	0.0 MIN
LUNCH	35.53 MIN
TOTAL FACE TIME	324.65 MIN

## 1. ROOF WALTER ACTIVITIES

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
MANTHIP -IN	1.	52.30	52.30	0.0	52.30	52.30
FACETHIP -IN	1.	5.57	5.57	0.0	5.57	5.57
INITIAL PREPARATION	1.	16.07	16.07	0.0	16.07	16.07
MARK ROOF	1.	3.22	3.22	0.0	3.22	3.22
POSITION DRILL	48.	40.18	0.84	0.86	4.67	0.12
DRILL STARTER HOLE	50.	57.38	1.15	0.16	1.43	0.77
INSERT AND TIGHTEN ROOF BOLT	50.	22.67	0.45	0.14	0.97	0.32
PREPARE FOR PLACE CHANGE	4.	5.92	1.48	1.07	3.27	0.42
FORWARD TRAM	7.	3.14	0.45	0.17	0.70	0.11
MANUEVER FOR TURN	2.	0.41	0.20	0.18	0.39	0.02
PREPARE FOR DEPARTURE	1.	0.62	0.62	0.0	0.62	0.62
FACETHIP -OUT	1.	28.05	28.05	0.0	28.05	28.05
MANTHIP -OUT	1.	37.72	37.72	0.0	37.72	37.72

## 2. ROOF WALTER DELAYS

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
CABLE HANDLING	3.	0.89	0.30	0.10	0.42	0.17
INSPECTION AND PREP. OF ROOM	1.	6.62	6.62	0.0	6.62	6.62
MECHANICAL DELAY-UNSCHEMED	1.	7.72	7.72	0.0	7.72	7.72
SUCTION DELAY	13.	7.75	0.77	1.38	4.90	0.22
SUPPLY DELAY	1.	11.47	11.47	0.0	11.47	11.47
SAFETY JACK	1.	6.68	6.68	0.0	6.68	6.68
PLACE DELAY -LOADER	3.	108.39	36.13	0.87	37.27	35.17
TRAFFIC DELAY -CUTTER	1.	3.77	3.77	0.0	3.77	3.77
LUNCH	1.	35.97	35.97	0.0	35.97	35.97
OTHER DELAY -SYSTEM	4.	11.24	2.81	3.41	8.68	0.45
CHANGE DRILL HIT	1.	0.30	0.30	0.0	0.30	0.30

## 3. PLACE CHANGE (TRAM)

TRAN TIME BEGIN END DELAY COORDINATES .....

1.64	497.63	534.43	35.16	13	23	33	43	40
1.77	566.09	616.03	48.18	40	43	33	38	
1.70	644.87	700.47	11.95	34	33	23	24	2L
0.63	743.47	744.12	0.02	2L	24	20		
1.01	773.89	814.10	40.41	20	23	33	43	40

## 4. TOTAL ROOF WALTERS INSERTED = 50 WALTERS

5. OPERATING TIME .....	142.48 MIN
NON-MAINTENANCE DELAYS-NECESSARY .....	33.78 MIN
NON-MAINTENANCE DELAYS-UNNECESSARY ..	134.87 MIN
PREVENTIVE MAINTENANCE DELAYS .....	0.0 MIN
CORRECTIVE MAINTENANCE DELAYS .....	7.72 MIN
LUNCH .....	35.97 MIN
TOTAL FACE TIME .....	318.87 MIN

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## 1. WORK MULTIPLE ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MANTHIP - IN	1.	15.27	15.27	0.0	15.27	15.27
FACETIMP - IN	1.	1.83	1.83	0.0	1.83	1.83
INITIAL PREPARATION	1.	4.40	4.40	0.0	4.40	4.40
POSITIONING MILL	84.	26.59	0.30	0.18	0.87	0.08
MILL STARTER - MLE	90.	51.92	0.58	0.14	1.23	0.42
CHANGE STEEL	26.	4.96	0.34	0.13	0.72	0.22
UNLIT MLE	25.	23.87	0.95	0.42	2.30	0.42
INSFRT AND TIGHTEN WORK MLE	89.	24.53	0.33	0.18	1.08	0.18
FACE TRAM	6.	4.82	0.77	0.08	0.87	0.62
PREPARE FIM PLACE CHANGE	10.	3.49	0.35	0.16	0.63	0.15
FORWARD TRAM	17.	9.15	0.54	0.11	0.82	0.28
MANEUVER FIM TURN	11.	2.96	0.27	0.09	0.42	0.13
REVERSE TRAM	16.	8.88	0.55	0.07	0.69	0.40
PREPARE FIM ON-PARTIME	1.	0.17	0.17	0.0	0.17	0.17
FACETIMP - UNIT	1.	26.10	26.10	0.0	26.10	26.10
MANTHIP - UNIT	1.	14.45	14.45	0.0	14.45	14.45

## 2. WORK MULTIPLE DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE MANIPULATION	0.	0.24	1.03	1.03	3.53	0.20
INSPECTION AND PREP. OF WORK	3.	4.11	1.37	0.81	2.50	0.63
SECTION POWER DOWN	2.	2.97	1.48	0.16	1.65	1.32
MECHANICAL DELAY-UNSCHEMELD	1.	8.63	0.63	0.0	8.63	8.63
SUCTION DELAY	9.	12.26	1.36	0.81	2.80	0.17
WAITING ON OTHER MILL	14.	17.08	0.95	0.73	2.83	0.05
PLACE DELAY - LUMEN	4.	44.65	21.16	5.57	30.57	16.02
INSERT WORK	14.	2.07	0.15	0.06	0.30	0.08
CLEAN UNIT COLLECTION	2.	2.95	1.48	0.04	1.52	1.43
TRAFFIC DELAY - LOADER	1.	0.55	0.55	0.0	0.55	0.55
TRAFFIC INLAY - SHUTTLE CAR	3.	4.82	1.61	0.72	2.37	0.65
TRAFFIC DELAY - SCUM	2.	7.19	3.59	3.42	7.02	0.17
MOLTING UNIT IN PLACE	1.	7.93	7.93	0.0	7.93	7.93
LUNCH	1.	38.77	38.77	0.0	38.77	38.77
LUMEN MLE	1.	9.27	9.27	0.0	9.27	9.27
OTHER DELAY - MACHINE	1.	0.63	0.63	0.0	0.63	0.63
OTHER DELAY - SYSTEM	7.	9.00	1.29	1.05	3.27	0.28
CHANGE MILL MLE	1.	0.45	0.45	0.0	0.45	0.45
WORK SCALING	1.	3.67	3.67	0.0	3.67	3.67

## 3. PLACE CHANGE (THAM)

TRAM TIME	MEAN	END	DELAY	CUMULATES
1.01	445.21	442.80	2.41	42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
2.70	475.14	473.42	1.72	
1.14	494.55	492.80	1.75	
3.75	501.49	500.91	0.58	
3.05	527.51	524.72	2.79	
2.54	575.47	574.24	1.23	
2.50	610.00	603.42	6.58	
1.04	724.11	723.42	0.69	
3.72	742.14	738.01	4.13	

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## 1. WORK MULTIM ACTIVITIES

	PRED.	EST. TIME	MEAN	STD. DEV.	HIGH	LOW
MANIP - IN	1.	15.27	15.27	0.0	15.27	15.27
FACTORY - IN	1.	1.83	1.83	0.0	1.83	1.83
INITIAL PREPARATION	1.	4.40	4.40	0.0	4.40	4.40
POSITIONING	4.	15.68	0.37	1.23	12.22	0.08
WILL STARTED	4.	63.75	0.66	0.13	1.23	0.43
CHANGE	17.	5.40	0.32	0.10	0.58	0.18
WILL	17.	16.05	0.48	0.12	1.15	0.60
INSERT AND	4.	31.00	0.32	0.21	1.90	0.17
FACE	6.	4.62	0.77	0.08	0.87	0.62
PREPARE	10.	3.51	0.35	0.16	0.63	0.17
FINISH	17.	7.15	0.54	0.11	0.82	0.28
MANIP - IN	11.	2.96	0.27	0.09	0.42	0.13
REVERSE	14.	8.88	0.55	0.07	0.69	0.40
FACTORY - IN	1.	26.10	26.10	0.0	26.10	26.10
MANIP - IN	1.	14.45	14.45	0.0	14.45	14.45

## 2. WORK MULTIM DELAYS

	PRED.	EST. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE MANIP	4.	8.24	1.03	1.03	3.53	0.20
INSPECTION AND	3.	3.81	1.27	0.91	2.50	0.33
SECTION	2.	2.97	1.48	0.16	1.65	1.32
MECHANICAL	1.	3.58	3.58	0.0	3.58	3.58
SCTION	1.	0.17	0.17	0.0	0.17	0.17
WAITING	17.	26.10	1.54	2.45	16.57	0.08
PLACE	4.	44.65	21.16	5.57	30.57	16.02
INSERT	25.	3.42	0.14	0.04	0.27	0.10
CLEAN	2.	2.95	1.48	0.04	1.52	1.43
TRAFFIC	1.	0.55	0.55	0.0	0.55	0.55
TRAFFIC	3.	4.42	1.61	0.72	2.37	0.65
TRAFFIC	2.	7.14	3.59	3.42	7.02	0.17
WOLTING	1.	7.93	7.93	0.0	7.93	7.93
LUNCH	1.	38.77	38.77	0.0	38.77	38.77
LOOSE	4.	7.43	1.86	1.07	3.53	0.62
OTHER	1.	4.50	1.50	1.27	3.27	0.33
WORK	1.	4.83	2.94	2.26	5.67	0.13

## 3. PLACE CHANGE (PAM)

TRAM TIME	MEAN	STD. DEV.	DELAY	CUMULATES
1.01	445.23	444.00	2.70	42 43 44 45
2.28	445.15	441.92	3.77	46 47 48 49
1.14	445.00	442.00	0.21	50 51 52 53
3.75	445.00	441.93	4.10	54 55 56 57
3.05	445.00	441.92	0.16	58 59 60 61
2.94	445.00	441.95	16.24	62 63 64 65
2.04	445.00	441.92	10.92	66 67 68 69
1.04	445.00	441.92	0.24	70 71 72 73
3.77	445.00	441.93	2.77	74 75 76 77
2.04	445.00	441.92	2.77	78 79 80 81
3.17	445.00	441.93	1.00	82 83 84 85

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## 1. ROOF BOLT ACTIVITIES

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
MANTRIP -IN	1.	16.54	16.54	0.0	16.54	16.54
FACTTRIP -IN	1.	4.23	4.23	0.0	4.23	4.23
POSITION DRILL	64.	19.83	0.31	0.31	2.37	0.05
DRILL STARTER HOLE	65.	37.73	0.58	0.14	1.04	0.20
CHANGE STEEL	21.	6.74	0.32	0.11	0.55	0.20
DRILL HOLE	21.	23.49	1.12	0.37	2.18	0.53
INSERT AND TIGHTEN BOLT	65.	24.21	0.37	0.16	0.87	0.20
FACE TRAM	8.	7.15	0.89	0.20	1.15	0.42
PREPARE FOR PLACE CHANGE	5.	1.21	0.24	0.07	0.32	0.12
FORWARD TRAM	12.	6.45	0.54	0.06	0.65	0.43
MANEUVER FOR TURN	7.	2.48	0.35	0.18	0.78	0.22
REVERSE TRAM	11.	6.70	0.61	0.09	0.80	0.48
PREPARE FOR DEPARTURE	1.	0.02	0.02	0.0	0.02	0.02
FACTTRIP -OUT	1.	18.08	18.08	0.0	18.08	18.08
MANTRIP -OUT	1.	14.73	14.73	0.0	14.73	14.73

## 2. ROOF BOLT DELAYS

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
CABLE HANDLING	1.	3.23	1.08	0.69	1.92	0.23
INSPECTION AND PREP. OF ROOM	1.	0.47	0.47	0.0	0.47	0.47
SECTION POWER DOWN	1.	0.77	0.77	0.0	0.77	0.77
SUCTION DELAY	2.	0.95	0.48	0.13	0.60	0.35
SUPPLY DELAY	5.	27.85	5.57	4.05	11.02	0.58
WAITING ON OTHER DRILL	7.	7.64	1.09	0.72	2.18	0.22
SAFETY JACK/TIMERS	13.	40.24	3.10	2.04	8.37	0.40
PLACE DELAY -LOADER	3.	46.12	28.71	17.54	44.10	4.17
INSERT WRENCH	16.	2.54	0.16	0.07	0.32	0.08
CLEAN DUST COLLECTION	1.	0.58	0.58	0.0	0.58	0.58
TRAINING DELAY -45C.	2.	0.75	0.38	0.09	0.47	0.28
TRAFFIC DELAY -SHUTTLE CAR	2.	2.32	1.16	0.01	1.17	1.15
TRAFFIC DELAY -SCARP	2.	18.23	9.11	8.91	18.03	0.20
LUNCH	1.	28.35	28.35	0.0	28.35	28.35
OTHER DELAY -SAFETY	3.	25.85	8.62	6.75	18.15	3.37
OTHER DELAY -MACHINE	5.	3.21	0.64	0.65	1.77	0.12
OTHER DELAY -SYSTEM	12.	5.49	0.46	0.30	1.25	0.17
OPERATION DELAY	6.	4.91	0.82	0.67	1.77	0.23
OTHER DELAY -CONDITIONS	1.	0.38	0.38	0.0	0.38	0.38
CHANGE DRILL BIT	2.	6.93	3.01	2.18	5.20	0.83
ROOF SCALING	9.	9.64	1.07	0.97	3.68	0.32

## 3. PLACE CHANGE (TRAM)

TRAM TIME	OFFIN	FIN	DELAY	COORDINATES
3.04	463.47	456.53	1.04	43 73 23 2L
1.44	471.40	473.13	0.35	20 23 13 10
4.31	501.40	555.30	40.14	14 13 23 33
3.15	597.13	616.23	19.50	01 65 64 63
3.31	602.54	642.94	31.04	71 55 54 53
1.10	763.50	776.23	7.55	41 66 43 33

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## 1. ROOF MOLTEN ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MANIP -IN	1.	16.58	16.58	0.0	16.58	16.58
FACETHIP -IN	1.	4.23	4.23	0.0	4.23	4.23
POSITION DRILL	77.	18.37	0.24	0.19	1.47	0.05
DRILL STARTER WOLF	78.	46.24	0.59	0.08	0.96	0.42
CHANGE STEEL	26.	6.30	0.24	0.06	0.40	0.07
DRILL HOLE	26.	25.60	0.98	0.18	1.74	0.72
INSERT AND TIGHTEN ROOF BOLT	74.	26.42	0.34	0.15	0.83	0.18
FACE TRAM	8.	7.15	0.89	0.26	1.15	0.42
PREPARE FOR PLACE CHANGE	5.	1.21	0.24	0.07	0.32	0.12
FORWARD TRAM	12.	6.45	0.54	0.06	0.65	0.43
MANUEVER FOR TURN	7.	2.48	0.35	0.18	0.78	0.22
REVERSE TRAM	11.	6.70	0.61	0.09	0.80	0.48
PREPARE FOR DEPARTURE	1.	0.02	0.02	0.0	0.02	0.02
FACETHIP -OUT	1.	18.08	18.08	0.0	18.08	18.08
MANIP -OUT	1.	14.73	14.73	0.0	14.73	14.73

## 2. ROOF MOLTEN DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE HANDLING	3.	3.23	1.08	0.69	1.92	0.23
INSPECTION AND PREP. OF ROOM	1.	0.47	0.47	0.0	0.47	0.47
SECTION POWER DOWN	1.	0.77	0.77	0.0	0.77	0.77
SUPPLY DELAY	3.	25.79	8.60	1.91	10.42	6.25
WAITING IN OTHER DRILL	7.	10.36	1.48	1.00	3.27	0.17
SAFETY JACK/TIMERS	12.	35.16	2.93	2.17	8.37	0.25
PLACE DELAY -LOADER	3.	46.12	28.71	17.54	44.10	4.17
INSERT WRENCH	14.	6.69	0.14	0.04	0.28	0.10
CLEAN DUST COLLECTOR	1.	0.58	0.58	0.0	0.58	0.58
TORQUE TEST	1.	0.33	0.33	0.0	0.33	0.33
TRAMMING DELAY -MSC.	2.	0.75	0.38	0.09	0.47	0.28
TRAFFIC DELAY -SHUTTLE CAR	2.	2.32	1.16	0.01	1.17	1.15
TRAFFIC DELAY -SCOOP	2.	18.23	9.11	8.91	18.03	0.20
GAS CHECK	2.	0.63	0.31	0.21	0.53	0.10
LUNCH	1.	28.35	28.35	0.0	28.35	28.35
OTHER DELAY -SAFETY	3.	24.75	8.25	7.00	18.15	3.23
OTHER DELAY -MACHINE	5.	3.61	0.72	0.58	1.77	0.23
OTHER DELAY -SYSTEM	10.	4.89	0.49	0.33	1.25	0.13
OPERATION DELAY	7.	5.20	0.74	0.65	1.77	0.08
CHANGE DRILL BIT	1.	5.20	5.20	0.0	5.20	5.20
ROOF SCALING	2.	5.21	2.60	1.08	3.68	1.53

## 3. PLACE CHANGE (TPAM)

TRAM TIME	MEAN	END	DELAY	COORDINATES
3.94	449.47	454.53	1.08	43 13 23 2L
1.44	471.30	473.13	0.35	20 23 13 10
4.31	501.44	556.30	50.14	14 13 23 33
3.15	507.14	536.43	44.50	6L 65 04 23
3.11	643.55	649.04	14.09	5L 55 53 44
3.10	703.54	710.23	7.55	4L 44 43 33

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1. ROOF MOUNT ACTIVITIES

	PREC.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
MANTRIP -IN	1.	31.00	31.00	0.0	31.00	31.00
FACETRIP -IN	1.	7.00	7.00	0.0	7.00	7.00
INITIAL PREPARATION	1.	11.62	11.62	0.0	11.62	11.62
MARK ROOF	6.	16.27	2.71	0.91	4.52	1.90
POSITION DRILL	97.	49.81	0.51	0.35	2.83	0.15
DRILL STARTER HOLE	98.	35.25	0.36	0.21	0.87	0.05
CHANGE STEEL	16.	13.04	3.17	0.09	0.60	0.08
DRILL HOLE	16.	21.85	0.29	0.08	0.67	0.12
INSERT AND TIGHTEN ROOF BOLT	98.	35.98	0.37	0.17	1.10	0.15
FACE TRAM	1.	0.48	0.48	0.0	0.48	0.48
PREPARE FIVE PLACE CHANGE	7.	2.61	0.37	0.23	0.90	0.20
FORWARD TRAM	10.	4.60	0.47	0.13	0.67	0.26
PREPARE FOUR DEPARTURE	1.	1.55	1.55	0.0	1.55	1.55
FACETRIP -OUT	1.	14.00	14.00	0.0	14.00	14.00
MANTRIP -OUT	1.	40.00	40.00	0.0	40.00	40.00

2. ROOF MOUNT DELAYS

	PREC.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
CABLE HANDLING	2.	2.83	1.41	0.11	1.53	1.30
SUCTION DELAY	6.	5.71	0.95	1.32	3.88	0.18
SUPPLY DELAY	3.	4.42	1.47	0.81	2.47	0.48
PLACE DELAY -LOUVER	6.	137.64	22.94	23.96	68.02	1.93
CLEAN DUST COLLECTION	2.	2.77	1.38	0.72	2.10	0.67
SHOOTING DELAY	1.	1.48	1.48	0.0	1.48	1.48
TRAMMING DELAY -MSC.	2.	0.20	0.10	0.02	0.12	0.08
TRAFFIC DELAY -OUTER	1.	2.68	2.68	0.0	2.68	2.68
TRAFFIC DELAY -SHUTTLE CAR	1.	4.00	4.00	0.0	4.00	4.00
LOOSE MOLT	1.	0.55	0.55	0.0	0.55	0.55
OTHER DELAY -MACHINE	1.	0.52	0.52	0.0	0.52	0.52
OTHER DELAY -SYSTEM	1.	2.03	2.03	0.0	2.03	2.03
OPERATION DELAY	2.	1.28	0.64	0.46	1.10	0.18
CHANGE DRILL HIT	1.	4.55	1.52	0.28	1.75	1.13

3. PLACE CHANGE (TRAM)

TRAM TIME (HOURS)	END	DELAY	COORDINATES
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1.00	472.67	481.25	6.43	32	33	43	53	50
1.09	519.65	520.71	-0.01	50	53	43	40	
0.45	543.57	511.92	52.50	40	41	33	30	
1.14	652.24	664.75	6.33	31	33	23	2L	
1.34	747.40	750.67	1.23	50	53	43	40	
1.45	771.87	714.70	60.14	40	43	33	30	

4. TOTAL ROOF MOUNT DELAYS = 94 HOURS

5. OPERATING TIME	17.00 HRS
NON-MANIPULATION DELAYS -DRILL STARTER	34.52 MIN
NON-MANIPULATION DELAYS -LOUVER CHANGE	132.77 MIN
NON-MANIPULATION DELAYS -SHUTTLE CAR	0.00 MIN

## 1. ROOF WOLTER ACTIVITIES

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
MANTRIP -IN	1.	30.00	30.00	0.0	30.00	30.00
FACETRIP -IN	1.	9.00	9.00	0.0	9.00	9.00
INITIAL PREPARATION	1.	8.30	8.30	0.0	8.30	8.30
MARK ROOF	2.	3.63	1.81	0.44	2.25	1.38
POSITION INWILL	95.	43.74	0.46	0.26	1.97	0.07
DRILL STARTER WOLE	95.	32.74	0.35	0.20	1.00	0.07
CHANGE STEEL	74.	12.71	0.17	0.09	0.48	0.07
DRILL WOLE	74.	22.15	0.30	0.05	0.47	0.20
INSERT AND TIGHTEN ROOF HOLT	95.	34.07	0.36	0.17	1.07	0.18
PREPARE FOR PLACE CHANGE	11.	2.50	0.23	0.13	0.47	0.03
FORWARD TEAM	17.	7.10	0.42	0.13	0.71	0.23
PREPARE FOR DEPARTURE	1.	0.19	0.0	0.0	0.19	0.19
FACETRIP -OUT	1.	9.98	9.98	0.0	9.98	9.98
MANTRIP -OUT	1.	40.00	40.00	0.0	40.00	40.00

## 2. ROOF WOLTER DELAYS

	FREQ.	TOT. TIME	MEAN	STD. DEV.	HIGH	LOW
CABLE HANDLING	5.	7.38	1.48	0.76	2.28	0.45
SUCTION DELAY	12.	3.71	0.31	0.35	1.40	0.05
SUPPLY DELAY	6.	11.72	1.95	0.68	2.67	0.98
SAFETY JACK	1.	0.73	0.73	0.0	0.73	0.73
PLACE DELAY -LOADER	5.	134.67	26.93	22.06	66.02	5.40
CLEAN DUST COLLECTOR	3.	4.35	1.45	0.45	2.08	1.12
TRAMMING INLAY -MSC.	3.	1.18	0.39	0.13	0.53	0.22
TRAFFIC DELAY -LOADER	3.	25.32	8.44	5.61	16.27	2.35
HOLTING OUT OF PLACE	2.	3.59	1.80	0.12	1.92	1.67
LOOSE HOLT	3.	1.18	0.39	0.15	0.52	0.18
OTHER DELAY -MACHINE	1.	0.20	0.20	0.0	0.20	0.20
OTHER DELAY -SYSTEM	2.	4.68	2.34	1.29	3.63	1.05
OPERATOR DELAY	6.	9.52	1.59	0.58	2.18	0.73
OTHER DELAY -CONDITIONS	1.	0.68	0.68	0.0	0.68	0.68
CHANGE DRILL BIT	3.	2.52	0.84	0.12	1.00	0.70
ROOF SCALING	2.	7.16	3.58	2.30	5.88	1.28

## 3. PLACE CHANGE (TPAM)

TRAM TIME	BEGIN	END	DELAY	COORDINATES
0.65	469.17	446.47	17.05	50 54 44 40
1.10	502.04	573.15	69.97	40 44 34 30
1.46	612.35	623.65	2.44	30 34 24 20
0.66	635.58	646.34	4.22	20 24 14 10
2.12	651.95	676.43	20.36	10 14 24 34
0.87	690.67	642.70	1.16	50 54 44 40
0.97	705.33	743.55	17.25	40 44 34 30
0.76	740.43	764.57	3.48	30 33 23 20
0.48	779.42	771.75	0.45	20 24 14 10
1.95	782.37	791.43	7.61	10 14 24 34
1.22	820.92	824.22	2.04	50 54 44 40



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# ROOF WALTER ACTIVITIES

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
MANTRIP -IN	1.	21.42	21.42	0.0	21.42	21.42
FACETRIP -IN	1.	17.90	17.90	0.0	17.90	17.90
INITIAL PREPARATION	1.	5.30	5.30	0.0	5.30	5.30
POSITION DRILL	51.	26.74	0.52	0.18	1.00	0.03
DRILL STARTER HOLE	51.	16.89	0.13	0.18	0.90	0.15
CHANGE STEEL	50.	12.17	0.24	0.06	0.35	0.15
DRILL HOLE	50.	16.23	0.32	0.11	0.67	0.23
INSERT AND TIGHTEN ROOF HOLE	51.	25.98	0.51	0.19	1.12	0.27
PREPARE FOR PLACE CHANGE	4.	4.53	1.13	1.26	3.28	0.05
FORWARD TEAM	11.	7.77	0.71	0.31	1.50	0.30
MANEUVER FOR TURN	1.	6.28	0.28	0.0	0.28	0.28
PREPARE FOR DEPARTURE	1.	2.25	2.25	0.0	2.25	2.25
FACETRIP -OUT	1.	22.08	22.08	0.0	22.08	22.08
MANTRIP -OUT	1.	14.92	14.92	0.0	14.92	14.92

## 2. ROOF BOLTER DELAYS

	FREQ.	TOT.TIME	MEAN	STD.DEV	HIGH	LOW
CAHLE MANAGING	9.	9.06	1.01	0.51	2.12	0.48
INSPECTION AND PREP. OF ROOM	1.	0.78	0.78	0.0	0.78	0.78
SECTION POWER DOWN	2.	6.82	3.41	3.16	5.57	0.25
MECHANICAL DELAY-UNSCHEDULED	1.	16.98	16.98	0.0	16.98	16.98
SUPPLY DELAY	1.	4.08	4.08	0.0	4.08	4.08
SAFETY JACK	7.	6.55	0.94	0.43	1.42	0.40
PLACE DELAY -LOADER	3.	114.91	38.30	11.59	54.18	26.85
CLEAN DUST COLLECTOR	3.	8.70	2.90	0.98	4.23	1.59
THAMMING DELAY -MISC.	2.	0.43	0.42	0.31	0.73	0.10
TRAFFIC DELAY -CHAL DRILL	2.	1.83	0.91	0.41	1.33	0.50
TRAFFIC DELAY -LOADER	1.	0.65	0.65	0.0	0.65	0.65
HOLTING OUT OF PLACE	1.	48.20	48.20	0.0	48.20	48.20
GAS CHECK	4.	3.82	0.95	0.27	1.27	0.55
OTHER DELAY -MACHINE	1.	0.67	0.67	0.0	0.67	0.67
OTHER DELAY -SYSTEM	5.	4.56	0.91	0.61	1.73	0.25
ROOF SCALING	6.	54.63	9.10	11.32	33.55	0.20

## 3. PLACE CHANGE (THAM)

THAM TIME	BEGIN	END	DELAY	COORDINATES
2.20	474.00	479.00	2.00	34 33 23 24 20
1.41	495.33	501.85	5.11	20 24 14 10
5.16	526.35	564.62	33.11	10 14 24 23 33
1.96	545.95	574.10	46.14	50 54 44 40
1.65	650.03	713.74	62.10	40 44 34 30

## 4. TOTAL ROOF HOLE IS INSERTED = 51 HOURS

5. OPERATING TIME ..... 166.30 MIN  
 NON-MAINTENANCE DELAYS-MISCARY ..... 84.84 MIN  
 NON-MAINTENANCE DELAYS-UNPLESSARY .. 134.35 MIN  
 PREVENTIVE MAINTENANCE DELAYS ..... 8.0 MIN

APPENDIX C  
JWR Time Study Data

CONTINUOUS MINER ELEMENTAL TIMES PER SHIFTAUG. & SEPT. 1979 STUDIES

<u>ELEMENT</u>	<u>MINUTES/SHIFT</u>
CUTTING AND LOADING	68.23
CLEANING BY MINER	2.39
CUTTING W/O CAR	10.97
SWITCH WITH CAR	10.81
SWITCH NO CAR	13.43
CAR CHANGE (RESIDUAL)	58.59
PLACE CHANGE TRAM	19.58
PLACE CHANGE HANDLE CABLE	13.42
PLACE CHANGE SERVICE DUTIES	6.13
IN PLACE HANDLE CABLE	3.76
IN PLACE SERVICE DUTIES	34.36
MINE HEALTH AND SAFETY DELAY	23.01
MECHANICAL DELAY	93.44
COORDINATION DELAY	28.65
CONDITION DELAY	14.32
GASSED OUT	1.93
TRAVEL IN	39.42
TRAVEL OUT	<u>37.38</u>
TOTAL	479.82

# CHANGE IN PRODUCTIVITY BOLTER

SECTIONS 3,4,7,8,10

ELEMENT	TIME		TIME	
	PRE-IMPOSITION		POST-IMPOSITION	
Total Time -Portal to Portal	480.00	Min/U.S.		Min/U.S.
Total Travel Time	63.70	Min/U.S.		Min/U.S.
Check for Smoking Articles	0	Min/U.S.		Min/U.S.
Ventilation Delay	0	Min/U.S.		Min/U.S.
Start of Shift Inspection	10.54	Min/U.S.		Min/U.S.
Power, Belts, etc.	157.70	Min/U.S.		Min/U.S.
Install Hangers	0	Min/U.S.		Min/U.S.
Gross Time At Face	248.06	Min/U.S.		Min/U.S.
Cable Splices	1.21 Min.	.25 %	Min.	%
Instruments	2.83 Min.	.59 %	Min.	%
Illumination	0 Min.	0 %	Min.	%
Other Imposition(non-cycle)	0 Min.	0 %	Min.	%
Bolter Availability 51.68 % -	.84 % =	50.84 %	Min.	% = %
Net Time At Face	244.02	Min/U.S.		Min/U.S.
.23% Federal Inspection Time	.56	Min/U.S.		Min/U.S.
Adjusted Net Time At Face	243.46	Min/U.S.		Min/U.S.
Cable Handling	.84	Min/Place		Min/Place
Curtain Delay	2.42	Min/Place		Min/Place
Gas Check	.28	Min/Place		Min/Place
Tram Time (bolter)	4.39	Min/Place		Min/Place
Bolting Time (actual)	67.04	Min/Place		Min/Place
Other Cyclic Delays	10.03	Min/Place		Min/Place
Other Impositions (water, etc.)	.57	Min/Place		Min/Place
Net Place Time	85.57	Min/Place		Min/Place
Ave. Places per Shift	2.85	Places/Shift		Places/Shift
Ave. Place Measurement 6.27 'x 19.55'x	14.34	'x		'x
Ave. (by measurement) Raw Tons/Place	77.34	Tons		Tons
Ave. Raw Tons U.S.	220.42	Tons		Tons
% Washer Reject	45.90	%		%
Ave. Adjusted Clean Tons/U.S.	119.25	Tons		Tons

Ave. (Clean) Tons/U.S. (Pre.) - Ave. (Clean) Tons/U.S. (Post) X 100 = % Productivity Lo.  
Ave. (Clean) Tons/U.S. (Pre.)

## FROM STUDIES:

15.18" Rock  
60.05" Coal  
75.23" Total

## BULK DENSITY CALCULATION:

$$\frac{15.18}{75.23} (0.07 \frac{\text{tons}}{\text{ft}^3}) + \frac{60.05}{75.23} (0.038 \frac{\text{tons}}{\text{ft}^3}) = 0.044 \frac{\text{tons}}{\text{ft}^3}$$

Continuous Miner Elemental Times

MINUTES/SHIFT

SECTION	AVG. 4,5,9
TRAVEL IN	29.38
TRAVEL OUT	41.01
LOADING	79.37
IN PLACE SERVICE DUTIES	46.29
WAIT ON CAR	101.25
PLACE CHANGE TRAM	18.97
PLACE CHANGE HANDLE CABLE	7.93
OTHER PLACE CHANGE SERVICE DUTIES	0.66
MECHANICAL DELAY	81.49
CONDITIONS DELAY	9.96
COORDINATION DELAY	46.06
MINE HEALTH AND SAFETY DELAY	14.93
GASSED OUT	0.99
TOTAL	478.29

APPENDIX D

J.J. Davis Time Study Results

## COMPOSITE OF SHIFT ELEMENTS FOR THE CONTINUOUS MINER

Shift Elements	A*	B*	C	D	E	F	G	H	I**	J*	K**	L*	M*	Σ	Δ	Σ̄	0
Above Ground	-	5.0	6.5	-	-	-	-	8.7	-	-	-	-	-	15.20	.4	1.20	3.57
Portal Time (in)	35.0	34.6	31.5	30.0	28.49	44.0	19.90	31.3	5.0	-	25.0	37.0	129.0	215.19	5.4	26.90	21.19
Production	96.8	79.6	137.9	89.6	116.85	140.1	94.75	49.3	145.5	88.1	157.0	229.9	-	931.00	23.5	116.38	36.27
Place Change	5.7	-	-	-	-	62.1	12.77	-	156.7	-	-	-	5.7	231.57	5.8	28.95	55.9
Delay	54.6	3.4	121.0	23.9	216.46	172.0	303.35	213.0	-	39.0	241.0	66.5	3.4	1290.71	32.6	161.34	106.15
Idle	69.3	227.3	36.0	268.5	46.66	25.8	-	46.9	182.8	-	-	14.5	227.3	606.66	15.3	75.83	96.98
Cleanup	-	12.1	-	-	-	-	-	22.8	-	10.8	50.0	-	-	72.80	1.8	9.10	18.35
Maneuver and Tiem	-	63.0	-	-	37.59	-	23.74	29.6	-	60.6	35.0	27.4	-	122.93	3.1	15.37	16.85
Lunch	-	-	47.0	38.3	-	-	-	39.4	30.0	-	-	-	-	154.70	3.9	19.34	21.17
Service Equip.	-	-	65.7	-	-	-	-	-	-	-	-	-	-	65.70	1.7	8.21	23.23
Incomplete Data	180.7	18.6	-	-	-	-	-	-	-	281.5	-	62.7	94.6	-	-	-	-
Portal Time (out)	12.9	37.0	20.8	24.7	25.89	28.0	11.15	31.2	5.0	-	23.0	42.0	-	169.74	4.3	21.22	8.84
Above Ground	25.0	-	13.6	5.0	8.06	8.0	14.34	7.8	15.0	-	12.0	-	-	83.80	2.1	10.48	3.71
														3960.00	99.9	495.02	

\*Deleted from averages because of incomplete data.

\*\*Nine hour shift, all other sections worked eight hour shifts.

Source: Industrial Engineering Study of Continuous Mining Systems, J.J. Davis Associates.

## COMPOSITE OF SHIFT ELEMENTS FOR STANDARD HAULAGE VEHICLES

Shift Elements	A*	B*	C	D	E	F	G	H	I**	J*	L*	Z	V	X	Σ
Above Ground	-	5.0	6.5	-	-	-	-	6.7	-	-	-	15.20	.4	2.17	3.76
Portal Time (in)	35.0	34.0	31.5	30.0	28.49	44.0	19.90	31.3	-	-	37.0	190.19	5.5	27.17	12.04
Load	33.3	70.5	31.1	33.5	38.48	28.1	34.75	34.2	106.6	47.0	144.5	306.73	6.8	43.62	27.47
Tran	176.7	52.0	74.6	271.6	73.16	88.6	49.22	32.3	218.5	90.2	166.0	807.98	23.2	115.33	94.72
Discharge	***	39.5	20.2	***	30.27	27.1	13.90	12.7	43.7	***	***	147.87	4.2	21.12	15.14
Delay	-	-	-	-	196.52	153.7	280.91	252.8	46.9	11.2	26.5	930.83	26.7	132.96	117.94
Idle	16.4	223.4	234.7	76.9	28.97	38.6	21.02	-	69.3	50.5	-	469.49	13.5	67.07	74.62
Place Charge	-	-	-	-	50.16	63.9	34.81	29.6	-	-	-	178.47	5.1	25.50	26.46
Lunch	-	-	47.0	38.3	-	-	-	39.4	30.0	-	-	154.70	4.4	22.10	21.25
Incomplete Data	180.7	18.6	-	-	-	-	-	-	-	280.7	62.7	146.74	4.2	20.96	9.52
Portal Time (out)	12.9	37.0	20.8	24.7	25.89	28.0	11.15	31.2	5.0	-	42.0	71.80	2.1	10.26	3.96
Above Ground	25.0	-	8.0	5.0	8.06	8.0	14.34	7.8	15.0	-	-	66.20	1.9	9.46	3.73
												3486.20	100.0	498.04	

\*Deleted from averages because of incomplete data.

\*\*Nine hour shift, all other sections worked eight hour shifts.

\*\*\*Discharge times were combined with tram times.

Source: Industrial Engineering Study of Continuous Mining Systems, J.J. Davis Associates.



## COMPOSITE OF SHIFT ELEMENTS FOR OFF-STANDARD HAULAGE VEHICLES

Shift Elements	A*	D	E	F	G	L	C	E	V	X	Q
Above Ground	-	-	-	-	-	-	-	-	-	-	-
Portal Time (in)	35.0	30.0	28.49	44.0	19.90	-	37.0	122.39	6.4	30.60	9.98
Load	23.0	27.6	42.50	35.7	36.21	49.1	116.9	142.01	7.4	35.50	6.11
Tram	182.0	289.3	64.36	99.1	41.87	75.9	143.6	495.23	25.8	123.81	112.87
Discharge	***	***	37.96	31.2	14.02	***	***	83.18	4.3	20.80	17.14
Delay	-	-	172.07	128.7	281.97	16.3	33.9	582.74	30.4	145.69	116.59
Idle	21.4	65.1	50.32	41.2	25.67	-	43.9	182.29	9.5	45.57	16.52
Place Change	-	-	50.35	63.5	34.87	-	-	148.72	7.7	37.18	27.41
Lunch	-	38.3	-	-	-	-	-	38.30	2.0	9.58	19.15
Incomplete Data	180.7	-	-	-	-	292.2	62.7	-	-	-	-
Portal Time (Out)	12.9	24.7	25.89	28.0	11.15	-	42.0	89.74	4.7	22.44	7.65
Above Ground	25.0	5.0	8.06	8.0	14.34	-	-	35.40	1.8	8.85	3.93
								1920.00	100.0	480.02	

\*Deleted from averages because of incomplete data.

\*\*Nine hour shift, all other sections worked eight hour shifts.

\*\*\*Discharge times were combined with tram times.

Source: Industrial Engineering Study of Continuous Mining Systems, J.J. Davis Associates.

# COMPOSITE OF SHIFT ELEMENTS FOR ROOF BOLTERS

Shift Elements	A	B	C	D	E	F	G	H	I**	J*	K**	L	M*	I	N	X	O
Above Ground	-	5.00	6.50	-	-	-	-	-	-	-	-	-	-	11.50	.2	1.05	2.35
Portal Time (In)	35.00	34.00	31.50	30.00	28.49	44.00	19.90	31.30	5.00	-	25.00	37.00	-	321.19	5.9	29.20	10.18
Drill	32.98	41.80	45.65	52.45	35.37	79.65	46.14	89.48	35.93	30.89	19.18	13.85	41.0	492.48	9.1	44.17	22.81
Insert Steel	5.99	35.80	13.20	28.06	13.15	26.59	-	51.62	4.63	14.76	4.12	6.71	25.3	189.87	3.5	17.26	16.22
Set Bolts	7.67	16.93	25.23	24.76	17.98	25.54	20.06	42.22	12.10	16.71	7.26	11.37	41.6	211.12	3.9	19.19	10.16
Maneuver	6.66	32.14	25.13	38.89	31.54	15.23	25.52	16.53	42.28	16.35	6.92	5.52	30.0	243.86	4.5	22.17	15.57
Idle	120.62	277.33	254.27	231.13	157.70	24.93	67.48	34.50	371.79	-	435.79	331.89	-	2507.43	46.4	227.95	139.91
Delay	33.18	-	44.13	50.01	161.84	197.93	68.22	105.88	47.79	3.61	6.73	31.66	19.2	947.37	17.5	86.12	87.07
Place Change	-	-	-	-	-	30.15	-	27.63	-	-	-	-	110.3	57.78	1.1	5.25	11.70
Temporary Support	-	-	-	-	-	-	7.19	26.54	-	-	-	-	24.5	33.73	.6	3.07	8.08
Incomplete Data	-	-	-	-	-	-	-	-	-	397.68	-	-	187.3	-	-	-	-
Portal Time (out)	12.90	37.00	20.80	24.70	25.89	28.00	11.15	31.20	5.00	-	23.00	42.00	-	261.64	4.8	23.79	11.07
Above Ground	25.00	-	13.60	5.00	8.06	8.00	14.34	21.10	15.00	-	12.00	-	-	122.10	2.3	11.10	7.93
														5400.07	99.8	490.92	

\*Deleted from averages because of incomplete data.

\*\*Nine hour shift, all other sections worked eight hour shifts.

Source: Industrial Engineering Study of Continuous Mining Systems, J.J. Davis Associates.

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APPENDIX E  
Sample Questionnaire

## COAL MINING ACTIVITIES QUESTIONNAIRE

Objective

Under contract to Jet Propulsion Laboratories, we are estimating the consumption of man-machine resources over a variety of underground mining activity categories. Most of the information is being obtained through statistical processing of our COAL Data Files. However, certain man-machine functions are not available and must be obtained from estimates of experienced mining personnel.

The objective of this questionnaire is to identify activities performed during a shift for selected man-machine functions. The percentage or fraction of the shift allocated to these activities must be estimated for the following:

- o Section Foreman
- o Section Mechanic
- o Bratticeman
- o Utility Man
- o Rock Dusting Machine

Each subject is addressed separately and contains its own directions. A short background statement accompanies each section explaining the type of information needed for that particular person or machine.

For this questionnaire, a "shift" is defined as all shift time except mantrips and lunch. It is not necessary, how-

ever, to make estimates in minutes and then divide by shift time to get the correct percentage. The percentage or fraction estimates will be normalized to the correct base at a later date. Estimates should be based upon an average shift during a typical work week.

### Section Foreman

The Section Foreman has many responsibilities. He must get the section activities started as soon as possible upon arriving, occasionally check the miner and the bolter throughout the shift, and must make sure that the section is left in safe condition for the next crew. He may also have non-routine tasks which are only performed once or twice per week.

The section foreman's job responsibilities seem to change at certain points in the shift, and this questionnaire has been designed with the shift divided at five points in time:

- (1) Mantrip Arrives - begins the available shift time
- (2) Begin Normal Mining Operations - initial section preparation complete; start mining coal
- (3) Lunch - assumed to be the shift midpoint (e.g., 12 noon on an 8-4 shift)
- (4) Finish Normal Mining Operations - last cut mined; begin rockdusting, turn off power, etc.
- (5) Mantrip Leaves - ends available shift time.

The purpose of the questionnaire is to define the activities a foreman would normally perform during the time available between these five points. The questionnaire starts on the next page.

Activities Between Points (1) and (2) -- Mantrip Arrives - Begin Operations

1. What routine (daily) activities are performed during this time block? Please estimate the percentage/fraction of the block taken up by each activity. (Suggestion: list all activities first, then go back and assign percentages/fractions to each activity.)

Activity	Percentage/Fraction of Time Block
Total	1.0

2. If some non-routine tasks are performed during this time block, please indicate the day(s) and the percentage/fraction of the total time block taken up by the activity.

Activity	Check Appropriate Day					Percentage/Fraction of Time Block
	M	T	W	T	F	





• • • • •

1. What routine activities are performed during this time block? Please indicate the percentage/fraction for each activity.

Total	1.0
-------	-----

2. If some non-routine tasks are performed during this time block, please indicate which day(s) and the appropriate percentage/fraction.

Activity	Check Appropriate Day					Percentage/Fraction of Time Block
	M	T	W	T	F	



### Section Mechanic

The section mechanic's main responsibility is to maintain section equipment. It is first desired to determine how much time per shift is actually spent repairing or maintaining a piece of equipment. The second objective is to divide his repair time among equipment types. Finally, the mechanic's non-repair time is to be divided into miscellaneous activities.

The questionnaire starts below.

1. In your judgement, what percentage/fraction of the shift is actually spent repairing or maintaining section equipment?
2. Of this actual repair and maintenance time (including preventive maintenance), what percentage/fraction is spent on each machine? (Note: total must equal 1.0.)

Machine	Percentage/Fraction
Continuous Miner	
Shuttle Cars	
Roof Bolter	
Section Feeder/Breaker	
Other (specify)	
Total	1.0

3. How does the mechanic spend the remaining portion of the shift? (Note: "idle" is an acceptable answer.)

Activity	Percentage/Fraction of Time Block
Total	1.0

Bratticeman and Utility Man

It is realized that most mining sections do not have both a bratticeman and a utility man on the face crew simultaneously, and the job functions are therefore combined. For our needs, however, a distinction between the two jobs must be made.

Bratticeman

Bratticeman is a UMWA job title. This person's main responsibility is maintaining proper face ventilation by manipulating line curtains, brattices, tubing, etc. It is doubtful, however, that these responsibilities occupy the entire shift. The objective is to determine how the bratticeman spends his non-ventilation time. The questionnaire starts below.

1. What percentage/fraction of the shift does the bratticeman spend performing non-ventilation-related activities?
2. How is this non-ventilation-related time spent? Do not count lunch breaks and mantrip travel time.

Activity	Percentage/Fraction of Time Block
Total	1.0

Utility Man

The Utility Man usually does not have a single job responsibility. He works wherever he is needed on the section. He may be a bratticeman's shadow, a mechanic's helper, a scoop driver, a supply man, or even a coal shoveler at the belt feeder. The questionnaire begins below.

1. Assuming that a utility man was present on the section, how would his shift time (excluding lunch and mantrips) be spent? It is not necessary to break down the shift into fine percentages/fractions: estimates to the nearest 10 percent are more than adequate.

Activity	Percentage/Fraction of Time Block
Total	1.0

Additional Information

1. Annual mine production \_\_\_\_\_ raw tons/year.
2. Estimated total number of people (salaried and hourly) on payroll, divided into the following categories:

Surface Operations \_\_\_\_\_

Section Production \_\_\_\_\_

Other Underground \_\_\_\_\_

3. How is the "Other Underground" workforce split up?

<u>Job Function</u>	<u>Percentage of "Other Underground" Workforce</u>
Main Haulage	
Supply Sections	
Man Systems (Safety Inspectors, Fire Bosses, etc.)	
Section Equipment Maintenance	
Ventilation (other than section)	
Roof Support (other than section)	
Electrical Maintenance and In- stallation	
Supervisory	
Other (please specify):	
1.	
2.	
3.	
4.	
<b>TOTAL</b>	<b>1.0</b>

Note: Only rough estimates are needed -- it is not necessary to provide exact figures.

Comments (optional):